



STATE OF UTAH - DEPARTMENT OF ADMINISTRATIVE SERVICES

**Division of Facilities Construction and Management**

**DFCM**

## **STANDARD LOW BID PROJECT**

**June 5, 2007**

# **OFFICE REMODEL DIVISION OF OIL, GAS & MINING DEPARTMENT OF NATURAL RESOURCES SALT LAKE CITY, UTAH**

DFCM Project Number 07262500

WHW Engineering  
1354 East 3300 South #200  
Salt Lake City, Utah 84106

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Current copies of the following documents are hereby made part of these contract documents by reference. These documents are available on the DFCM web site at <http://dfcm.utah.gov> or are available upon request from DFCM.

DFCM General Conditions dated May 25, 2005.

DFCM Application and Certification for Payment dated May 25, 2005.

Technical Specifications :  
Drawings:

**The Agreement and General Conditions dated May 25, 2005 have been updated from versions that were formally adopted and in use prior to this date. The changes made to the General Conditions are identified in a document entitled Revisions to General Conditions that is available on DFCM's web site at <http://dfcm.utah.gov>**

## NOTICE TO CONTRACTORS

Sealed bids will be received by the Division of Facilities Construction and Management (DFCM) for:

**OFFICE REMODEL - DIVISION OF OIL, GAS & MINING**  
**DEPARTMENT OF NATURAL RESOURCES – SALT LAKE CITY, UTAH**  
**DFCM PROJECT NO: 07262500**

Bids will be in accordance with the Contract Documents that will be available at 2:00 PM on Tuesday June 5, 2007 and distributed in electronic format only on CDs from DFCM at the Wasatch Building at the Utah State Fairpark, approximately 155 North 1000 West, Salt Lake City, Utah and on the DFCM web page at <http://dfcm.utah.gov>. For questions regarding this project, please contact Mike Butler, DFCM, at 801-297-7759. No others are to be contacted regarding this bidding process. The construction budget for this project is \$121,000.00.

A **mandatory** pre-bid meeting will be held at 9:00 AM on Tuesday, June 12, 2007 at the Natural Resources Building, 1594 West Temple, Salt Lake City, Utah. Meet in the lobby. All bidders wishing to bid on this project are required to attend this meeting.

Bids will be received until the hour of 1:15 PM on Wednesday, June 20, 2007 at the Wasatch Building at the Utah State Fairpark, approximately 155 North 1000 West, Salt Lake City, Utah. Refer to the map on the DFCM website for directions ([http://dfcm.utah.gov/downloads/fairpark\\_map.pdf](http://dfcm.utah.gov/downloads/fairpark_map.pdf)). Bids will be opened and read aloud in the Wasatch Building at the Utah State Fairpark. NOTE: Bids must be received at the Wasatch Building at the Utah State Fairpark by the specified time.

A bid bond in the amount of five percent (5%) of the bid amount, made payable to the Division of Facilities Construction and Management on DFCM's bid bond form, shall accompany the bid.

The Division of Facilities Construction and Management reserves the right to reject any or all bids or to waive any formality or technicality in any bid in the interest of DFCM.

DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT  
Marla Workman, Contract Coordinator  
4110 State Office Building, Salt Lake City, Utah 84114

## PROJECT DESCRIPTION

### Proposed Scope of work:

1. First floor office renovations – offices affected:
  - a. Offices 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, and Storage.
  - b. Office entrance, waiting area, copper room, and reception.
    - i. Enclose walls for new office.
    - ii. Provide glass window in reception wall to waiting room.
    - iii. Provide counter from reception to public area 101.
    - iv. Provide glass door between waiting area and public area 101.
    - v. Provide push button for card access on two of the four new access readers located in the reception area.
    - vi. Addition of two exterior windows.
2. Mechanical HVAC relocations and VAV box additions if required by office changes and additions.
3. Lighting relocations.

Additive Alternate No. 1 - Provide electric door opener in lieu of the pneumatic type for two exit doors.

**PROJECT SCHEDULE**

| <b>PROJECT NAME: OFFICE REMODEL – DIVISION OF OIL, GAS &amp; MINING</b><br><b>DEPARTMENT OF NATURAL RESOURCES – SALT LAKE CITY, UTAH</b> |            |                   |             |  |
|--|------------|-------------------|-------------|--|
| <b>DFCM PROJECT #: 07262500</b>  |            |                   |             |  |
| <b>Event</b>   | <b>Day</b> | <b>Date</b>       | <b>Time</b> | <b>Place</b>   |
| Bidding Documents Available  | Tuesday    | June 5, 2007      | 2:00 PM     | Wasatch Building<br>Utah State Fairpark<br>Approx 155 North 1000 West<br>Salt Lake City, UT** and<br>DFCM web site * |
| <b>Mandatory</b> Pre-bid Site Meeting  | Tuesday    | June 12, 2007     | 9:00 AM     | Main Lobby<br>Natural Resources Building<br>1594 West Temple<br>SLC, UT  |
| Last Day to Submit Questions   | Monday     | June 18, 2007     | 9:00 AM     | Mike Butler - DFCM,<br>E-mail <a href="mailto:mcbutler@utah.gov">mcbutler@utah.gov</a><br>Fax 801-328-9356           |
| Prime Contractors Turn In Bid and Bid Bond   | Wednesday  | June 20, 2007     | 1:15 PM     | Wasatch Building<br>Utah State Fairpark<br>Approx 155 North 1000 West<br>Salt Lake City, UT **                       |
| Sub-contractor List Due  | Thursday   | June 21, 2007     | 1:15 PM     | DFCM<br>4110 State Office Bldg<br>SLC, UT<br>Fax 801-538-3677  |
| Substantial Completion Date  | Tuesday    | September 4, 2007 |             |  |

\* **NOTE:** DFCM's web site address is <http://dfcm.utah.gov>

\*\* **Due to the ongoing construction on Capitol Hill and the anticipated shortage of parking during 2007, all bids will be received and opened at the Wasatch Building at the Utah State Fairpark. Refer to map on the DFCM web site for directions ([http://dfcm.utah.gov/downloads/fairpark\\_map.pdf](http://dfcm.utah.gov/downloads/fairpark_map.pdf))**



STATE OF UTAH - DEPARTMENT OF ADMINISTRATIVE SERVICES

**Division of Facilities Construction and Management**

**DFCM**

## BID FORM

NAME OF BIDDER \_\_\_\_\_ DATE \_\_\_\_\_

To the Division of Facilities Construction and Management  
4110 State Office Building  
Salt Lake City, Utah 84114

The undersigned, responsive to the "Notice to Contractors" and in accordance with the "Instructions to Bidders", in compliance with your invitation for bids for the **OFFICE REMODEL – DIVISION OF OIL, GAS & MINING – DEPARTMENT OF NATURAL RESOURCES – SALT LAKE CITY, UTAH – DFCM PROJECT NO. 07262500** and having examined the Contract Documents and the site of the proposed Work and being familiar with all of the conditions surrounding the construction of the proposed Project, including the availability of labor, hereby proposes to furnish all labor, materials and supplies as required for the Work in accordance with the Contract Documents as specified and within the time set forth and at the price stated below. This price is to cover all expenses incurred in performing the Work required under the Contract Documents of which this bid is a part:

I/We acknowledge receipt of the following Addenda: \_\_\_\_\_

**BASE BID:** For all work shown on the Drawings and described in the Specifications and Contract Documents, I/we agree to perform for the sum of:

\_\_\_\_\_ DOLLARS (\$\_\_\_\_\_) (In case of discrepancy, written amount shall govern)

**ADDITIVE ALTERNATE NO. 1:** For all work shown on the Drawings and described in the Specifications and Contract Documents to provide an electric door opener in lieu of the pneumatic type for two exit doors, I/we agree to perform for the sum of:

\_\_\_\_\_ DOLLARS (\$\_\_\_\_\_) (In case of discrepancy, written amount shall govern)

I/We guarantee that the Work will be Substantially Complete by **September 4, 2007**, should I/we be the successful bidder, and agree to pay liquidated damages in the amount of **\$50.00** per day for each day after expiration of the Contract Time as stated in Article 3 of the Contractor's Agreement.

This bid shall be good for 45 days after bid opening.

Enclosed is a 5% bid bond, as required, in the sum of \_\_\_\_\_

The undersigned Contractor's License Number for Utah is \_\_\_\_\_.

Upon receipt of notice of award of this bid, the undersigned agrees to execute the contract within ten (10) days, unless a shorter time is specified in the Contract Documents, and deliver acceptable Performance and Payment bonds in the prescribed form in the amount of 100% of the Contract Sum for faithful performance of the contract.

The Bid Bond attached, in the amount not less than five percent (5%) of the above bid sum, shall become the property of the Division of Facilities Construction and Management as liquidated damages for delay and additional expense caused thereby in the event that the contract is not executed and/or acceptable 100% Performance and Payment bonds are not delivered within the time set forth.

Type of Organization:

\_\_\_\_\_  
(Corporation, Partnership, Individual, etc.)

Any request and information related to Utah Preference Laws:

\_\_\_\_\_

Respectfully submitted,

\_\_\_\_\_  
Name of Bidder

ADDRESS:

\_\_\_\_\_  
\_\_\_\_\_

\_\_\_\_\_  
Authorized Signature

# INSTRUCTIONS TO BIDDERS

## 1. Drawings and Specifications, Other Contract Documents

Drawings and Specifications, as well as other available Contract Documents, may be obtained as stated in the Invitation to Bid.

## 2. Bids

Before submitting a bid, each contractor shall carefully examine the Contract Documents, shall visit the site of the Work; shall fully inform themselves as to all existing conditions and limitations; and shall include in the bid the cost of all items required by the Contract Documents. If the bidder observes that portions of the Contract Documents are at variance with applicable laws, building codes, rules, regulations or contain obvious erroneous or uncoordinated information, the bidder shall promptly notify the DFCM Representative and the necessary changes shall be accomplished by Addendum.

The bid, bearing original signatures, must be typed or handwritten in ink on the Bid Form provided in the procurement documents and submitted in a sealed envelope at the location specified by the Invitation to Bid prior to the deadline for submission of bids.

Bid bond security, in the amount of five percent (5%) of the bid, made payable to the Division of Facilities Construction and Management, shall accompany bid. **THE BID BOND MUST BE ON THE BID BOND FORM PROVIDED IN THE PROCUREMENT DOCUMENTS IN ORDER TO BE CONSIDERED AN ACCEPTABLE BID.**

If the bid bond security is submitted on a bid bond form other than DFCM's required bid bond form, and the bid security meets all other legal requirements, the bidder will be allowed to provide an acceptable bid bond by the close of business on the next business day following notification by DFCM of submission of a defective bid bond security. **NOTE: A cashier's check cannot be used as a substitute for a bid bond.**

## 3. Contract and Bond

The Contractor's Agreement will be in the form found in the specifications. The Contract Time will be as indicated in the bid. The successful bidder, simultaneously with the execution of the Contract Agreement, will be required to furnish a performance bond and a payment bond, both bearing original signatures, upon the forms provided in the procurement documents. The performance and payment bonds shall be for an amount equal to one hundred percent (100%) of the contract sum and secured from a company that meets the requirements specified in the requisite forms. Any bonding requirements for subcontractors will be specified in the Supplementary General Conditions.

**4. Listing of Subcontractors**

Listing of Subcontractors shall be as summarized in the “Instructions and Subcontractor’s List Form”, which are included as part of these Contract Documents. The Subcontractors List shall be delivered to DFCM or faxed to DFCM at (801)538-3677 within 24 hours of the bid opening. Requirements for listing additional subcontractors will be listed in the Contract Documents.

DFCM retains the right to audit or take other steps necessary to confirm compliance with requirements for the listing and changing of subcontractors. Any contractor who is found to not be in compliance with these requirements is subject to a debarment hearing and may be debarred from consideration for award of contracts for a period of up to three years.

**5. Interpretation of Drawings and Specifications**

If any person or entity contemplating submitting a bid is in doubt as to the meaning of any part of the drawings, specifications or other Contract Documents, such person shall submit to the DFCM Project Manager a request for an interpretation thereof. The person or entity submitting the request will be responsible for its prompt delivery. Any interpretation of the proposed documents will be made only by addenda posted on DFCM’s web site at <http://dfcm.utah.gov>. Neither the DFCM nor A/E will be responsible for any other explanations or interpretations of the proposed documents. A/E shall be deemed to refer to the architect or engineer hired by DFCM as the A/E or Consultant for the Project.

**6. Addenda**

Addenda will be posted on DFCM’s web site at <http://dfcm.utah.gov>. Contractors are responsible for obtaining information contained in each addendum from the web site. Addenda issued prior to the submittal deadline shall become part of the bidding process and must be acknowledged on the bid form. Failure to acknowledge addenda may result in disqualification from bidding.

**7. Award of Contract**

The Contract will be awarded as soon as possible to the lowest, responsive and responsible bidder, based on the lowest combination of base bid and acceptable prioritized alternates, provided the bid is reasonable, is in the interests of the State of Utah to accept and after applying the Utah Preference Laws in U.C.A. Title 63, Chapter 56. DFCM reserves the right to waive any technicalities or formalities in any bid or in the bidding. Alternates will be accepted on a prioritized basis with Alternate 1 being highest priority, Alternate 2 having second priority, etc.

**8. DFCM Contractor Performance Rating**

As a contractor completes each DFCM project, DFCM, the architect/engineer and the using agency will evaluate project performance based on the enclosed “DFCM Contractor Performance Rating” form. The ratings issued on this project will not affect this project but may affect the award on future projects.

**9. Licensure**

The Contractor shall comply with and require all of its subcontractors to comply with the license laws as required by the State of Utah.

**10. Right to Reject Bids**

DFCM reserves the right to reject any or all Bids.

**11. Time is of the Essence**

Time is of the essence in regard to all the requirements of the Contract Documents.

**12. Withdrawal of Bids**

Bids may be withdrawn on written request received from bidder prior to the time fixed for opening. Negligence on the part of the bidder in preparing the bid confers no right for the withdrawal of the bid after it has been opened.

**13. Product Approvals**

Where reference is made to one or more proprietary products in the Contract Documents, but restrictive descriptive materials of one or more manufacturer(s) is referred to in the Contract Documents, the products of other manufacturers will be accepted, provided they equal or exceed the standards set forth in the drawings and specifications and are compatible with the intent and purpose of the design, subject to the written approval of the A/E. Such written approval must occur prior to the deadline established for the last scheduled addenda to be issued. The A/E's written approval will be in an issued addendum. If the descriptive material is not restrictive, the products of other manufacturers specified will be accepted without prior approval provided they are compatible with the intent and purpose of the design as determined by the A/E.

**14. Financial Responsibility of Contractors, Subcontractors and Sub-subcontractors**

Contractors shall respond promptly to any inquiry in writing by DFCM to any concern of financial responsibility of the contractor, subcontractor or sub-subcontractor.

**15. Debarment**

By submitting a bid, the Contractor certifies that neither it nor its principals, including project and site managers, have been, or are under consideration for, debarment or suspension, or any action that would exclude such from participation in a construction contract by any governmental department or agency. If the Contractor cannot certify this statement, attach to the bid a detailed written explanation which must be reviewed and approved by DFCM as part of the requirements for award of the Project.

## BID BOND

(Title 63, Chapter 56, U. C. A. 1953, as Amended)

### KNOW ALL PERSONS BY THESE PRESENTS:

That \_\_\_\_\_ hereinafter referred to as the "Principal," and \_\_\_\_\_, a corporation organized and existing under the laws of the State of \_\_\_\_\_, with its principal office in the City of \_\_\_\_\_ and authorized to transact business in this State and U. S. Department of the Treasury Listed, (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); hereinafter referred to as the "Surety," are held and firmly bound unto the STATE OF UTAH, hereinafter referred to as the "Obligee," in the amount of \$ \_\_\_\_\_ (5% of the accompanying bid), being the sum of this Bond to which payment the Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

**THE CONDITION OF THIS OBLIGATION IS SUCH** that whereas the Principal has submitted to Obligee the accompanying bid incorporated by reference herein, dated as shown, to enter into a contract in writing for the \_\_\_\_\_ Project.

**NOW, THEREFORE, THE CONDITION OF THE ABOVE OBLIGATION IS SUCH**, that if the said principal does not execute a contract and give bond to be approved by the Obligee for the faithful performance thereof within ten (10) days after being notified in writing of such contract to the principal, then the sum of the amount stated above will be forfeited to the State of Utah as liquidated damages and not as a penalty; if the said principal shall execute a contract and give bond to be approved by the Obligee for the faithful performance thereof within ten (10) days after being notified in writing of such contract to the Principal, then this obligation shall be null and void. It is expressly understood and agreed that the liability of the Surety for any and all defaults of the Principal hereunder shall be the full penal sum of this Bond. The Surety, for value received, hereby stipulates and agrees that obligations of the Surety under this Bond shall be for a term of sixty (60) days from actual date of the bid opening.

**PROVIDED, HOWEVER**, that this Bond is executed pursuant to provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on this Bond shall be determined in accordance with said provisions to same extent as if it were copied at length herein.

**IN WITNESS WHEREOF**, the above bounden parties have executed this instrument under their several seals on the date indicated below, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

**DATED** this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_.

**Principal's name and address (if other than a corporation):**

\_\_\_\_\_  
\_\_\_\_\_

By: \_\_\_\_\_

Title: \_\_\_\_\_

**Principal's name and address (if a corporation):**

\_\_\_\_\_  
\_\_\_\_\_

By: \_\_\_\_\_

Title: \_\_\_\_\_  
(Affix Corporate Seal)

**Surety's name and address:**

\_\_\_\_\_  
\_\_\_\_\_

By: \_\_\_\_\_  
Attorney-in-Fact (Affix Corporate Seal)

STATE OF \_\_\_\_\_ )  
COUNTY OF \_\_\_\_\_ ) ss.

On this \_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_, personally appeared before me \_\_\_\_\_, whose identity is personally known to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney-in-fact of the above-named Surety Company, and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_.

My Commission Expires: \_\_\_\_\_

Resides at: \_\_\_\_\_

Agency: \_\_\_\_\_  
Agent: \_\_\_\_\_  
Address: \_\_\_\_\_  
Phone: \_\_\_\_\_

NOTARY PUBLIC

Approved As To Form: May 25, 2005  
By Alan S. Bachman, Asst Attorney General

**Division of Facilities Construction and****INSTRUCTIONS AND SUBCONTRACTORS LIST FORM**

The three low bidders, as well as all other bidders that desire to be considered, are required by law to submit to DFCM within 24 hours of bid opening a list of **ALL** first-tier subcontractors, including the subcontractor's name, bid amount and other information required by Building Board Rule and as stated in these Contract Documents, on the following basis:

**PROJECTS UNDER \$500,000 - ALL SUBS \$20,000 OR OVER MUST BE LISTED**  
**PROJECTS \$500,000 OR MORE - ALL SUBS \$35,000 OR OVER MUST BE LISTED**

- Any additional subcontractors identified in the bid documents shall also be listed.
- The DFCM Director may not consider any bid submitted by a bidder if the bidder fails to submit a subcontractor list meeting the requirements of State law.
- List subcontractors for base bid as well as the impact on the list that the selection of any alternate may have.
- Bidder may not list more than one subcontractor to perform the same work.
- Bidder must list "Self" if performing work itself.

**LICENSURE:**

The subcontractor's name, the type of work, the subcontractor's bid amount, and the subcontractor's license number as issued by DOPL, if such license is required under Utah Law, shall be listed. Bidder shall certify that all subcontractors, required to be licensed, are licensed as required by State law. A subcontractor includes a trade contractor or specialty contractor and does not include suppliers who provide only materials, equipment, or supplies to a contractor or subcontractor.

**BIDDER LISTING 'SELF' AS PERFORMING THE WORK:**

Any bidder that is properly licensed for the particular work and intends to perform that work itself in lieu of a subcontractor that would otherwise be required to be on the subcontractor list, must insert the term 'Self' for that category on the subcontractor list form. Any listing of 'Self' on the sublist form shall also include the amount allocated for that work.

**'SPECIAL EXCEPTION':**

A bidder may list 'Special Exception' in place of a subcontractor when the bidder intends to obtain a subcontractor to perform the work at a later date because the bidder was unable to obtain a qualified or reasonable bid under the provisions of U.C.A. Section 63A-5-208(4). The bidder shall insert the term 'Special Exception' for that category of work, and shall provide documentation with the subcontractor list describing the bidder's efforts to obtain a bid of a qualified subcontractor at a reasonable cost and why the bidder was unable to obtain a qualified subcontractor bid. The Director must find that the bidder complied in good faith with State law requirements for any 'Special Exception' designation, in order for the bid to be considered. If awarded the contract, the Director shall supervise the bidder's efforts to obtain a qualified subcontractor bid. The amount of the awarded contract may not be adjusted to reflect the actual amount of the subcontractor's bid. Any listing of 'Special Exception' on the sublist form shall also include amount allocated for that work.

**INSTRUCTIONS AND SUBCONTRACTORS LIST FORM**  
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**GROUND FOR DISQUALIFICATION:**

The Director may not consider any bid submitted by a bidder if the bidder fails to submit a subcontractor list meeting the requirements of State law. Director may withhold awarding the contract to a particular bidder if one or more of the proposed subcontractors are considered by the Director to be unqualified to do the Work or for such other reason in the best interest of the State of Utah. Notwithstanding any other provision in these instructions, if there is a good faith error on the sublist form, at the sole discretion of the Director, the Director may provide notice to the contractor and the contractor shall have 24 hours to submit the correction to the Director. If such correction is submitted timely, then the sublist requirements shall be considered met.

**CHANGES OF SUBCONTRACTORS SPECIFICALLY IDENTIFIED ON SUBLIST FORM:**

Subsequent to twenty-four hours after the bid opening, the contractor may change its listed subcontractors only after receiving written permission from the Director based on complying with all of the following criteria.

- (1) The contractor has established in writing that the change is in the best interest of the State and that the contractor establishes an appropriate reason for the change, which may include, but not is not limited to, the following reasons: the original subcontractor has failed to perform, or is not qualified or capable of performing, and/or the subcontractor has requested in writing to be released.
- (2) The circumstances related to the request for the change do not indicate any bad faith in the original listing of the subcontractors.
- (3) Any requirement set forth by the Director to ensure that the process used to select a new subcontractor does not give rise to bid shopping.
- (4) Any increase in the cost of the subject subcontractor work is borne by the contractor.
- (5) Any decrease in the cost of the subject subcontractor work shall result in a deductive change order being issued for the contract for such decreased amount.
- (6) The Director will give substantial weight to whether the subcontractor has consented in writing to being removed unless the Contractor establishes that the subcontractor is not qualified for the work.

**EXAMPLE:**

Example of a list where there are only four subcontractors:

| TYPE OF WORK            | SUBCONTRACTOR,<br>"SELF" OR "SPECIAL EXCEPTION" | SUBCONTRACTOR<br>BID AMOUNT | CONT. LICENSE #                                      |
|-------------------------|---|-----------------------------|--|
| ELECTRICAL              | ABCD Electric Inc.                              | \$350,000.00                | 123456789000   |
| LANDSCAPING             | "Self"  | 300,000.00                  | 123456789000   |
| CONCRETE (ALTERNATE #1) | XYZ Concrete Inc                                | 298,000.00                  | 987654321000   |
| MECHANICAL              | "Special Exception"<br>(attach documentation)   | Fixed at: 350,000.00        | (TO BE PROVIDED<br>AFTER OBTAINING<br>SUBCONTRACTOR) |

**PURSUANT TO STATE LAW - SUBCONTRACTOR BID AMOUNTS CONTAINED IN THIS  
SUBCONTRACTOR LIST SHALL NOT BE DISCLOSED UNTIL THE CONTRACT HAS BEEN AWARDED.**

**SUBCONTRACTORS LIST**

FAX TO 801-538-3677

PROJECT TITLE: \_\_\_\_\_

Caution: You must read and comply fully with instructions.

| TYPE OF WORK | SUBCONTRACTOR,<br>"SELF" OR "SPECIAL EXCEPTION" | SUBCONTRACTOR<br>BID AMOUNT | CONT. LICENSE # |
|--------------|---|-----------------------------|-----------------|
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We certify that:

1. This list includes all subcontractors as required by the instructions, including those related to the base bid as well as any alternates.
2. We have listed "Self" or "Special Exception" in accordance with the instructions.
3. All subcontractors are appropriately licensed as required by State law.

FIRM: \_\_\_\_\_

DATE: \_\_\_\_\_

SIGNED BY: \_\_\_\_\_

**NOTICE:** FAILURE TO SUBMIT THIS FORM, PROPERLY COMPLETED AND SIGNED, AS REQUIRED IN THESE CONTRACT DOCUMENTS, SHALL BE GROUNDS FOR DFCMS REFUSAL TO ENTER INTO A WRITTEN CONTRACT WITH BIDDER. ACTION MAY BE TAKEN AGAINST BIDDERS BID BOND AS DEEMED APPROPRIATE BY DFCM. ATTACH A SECOND PAGE IF NECESSARY.

## CONTRACTOR'S AGREEMENT

FOR:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

THIS CONTRACTOR'S AGREEMENT, made and entered into this \_\_\_\_ day of \_\_\_\_\_, 20\_\_, by and between the DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT, hereinafter referred to as "DFCM", and \_\_\_\_\_, incorporated in the State of \_\_\_\_\_ and authorized to do business in the State of Utah, hereinafter referred to as "Contractor", whose address is \_\_\_\_\_.

WITNESSETH: WHEREAS, DFCM intends to have Work performed at \_\_\_\_\_.

WHEREAS, Contractor agrees to perform the Work for the sum stated herein.

NOW, THEREFORE, DFCM and Contractor for the consideration provided in this Contractor's Agreement, agree as follows:

**ARTICLE 1. SCOPE OF WORK.** The Work to be performed shall be in accordance with the Contract Documents prepared by \_\_\_\_\_ and entitled "\_\_\_\_\_"

The DFCM General Conditions ("General Conditions") dated May 25, 2005 on file at the office of DFCM and available on the DFCM website, are hereby incorporated by reference as part of this Agreement and are included in the specifications for this Project. All terms used in this Contractor's Agreement shall be as defined in the Contract Documents, and in particular, the General Conditions.

The Contractor Agrees to furnish labor, materials and equipment to complete the Work as required in the Contract Documents which are hereby incorporated by reference. It is understood and agreed by the parties hereto that all Work shall be performed as required in the Contract Documents and shall be subject to inspection and approval of DFCM or its authorized representative. The relationship of the Contractor to the DFCM hereunder is that of an independent Contractor.

**ARTICLE 2. CONTRACT SUM.** The DFCM agrees to pay and the Contractor agrees to accept in full performance of this Contractor's Agreement, the sum of \_\_\_\_\_ DOLLARS AND NO CENTS (\$\_\_\_\_\_.00), which is the base bid, and which sum also includes the cost of a 100% Performance Bond and a 100%

CONTRACTOR'S AGREEMENT  
PAGE NO. 2

Payment Bond as well as all insurance requirements of the Contractor. Said bonds have already been posted by the Contractor pursuant to State law. The required proof of insurance certificates have been delivered to DFCM in accordance with the General Conditions before the execution of this Contractor's Agreement.

**ARTICLE 3. TIME OF COMPLETION AND DELAY REMEDY.** The Work shall be Substantially Complete by \_\_\_\_\_. Contractor agrees to pay liquidated damages in the amount of \$\_\_\_\_\_ per day for each day after expiration of the Contract Time until the Contractor achieves Substantial Completion in accordance with the Contract Documents, if Contractor's delay makes the damages applicable. The provision for liquidated damages is: (a) to compensate the DFCM for delay only; (b) is provided for herein because actual damages can not be readily ascertained at the time of execution of this Contractor's Agreement; (c) is not a penalty; and (d) shall not prevent the DFCM from maintaining Claims for other non-delay damages, such as costs to complete or remedy defective Work.

No action shall be maintained by the Contractor, including its or Subcontractor or suppliers at any tier, against the DFCM or State of Utah for damages or other claims due to losses attributable to hindrances or delays from any cause whatsoever, including acts and omissions of the DFCM or its officers, employees or agents, except as expressly provided in the General Conditions. The Contractor may receive a written extension of time, signed by the DFCM, in which to complete the Work under this Contractor's Agreement in accordance with the General Conditions.

**ARTICLE 4. CONTRACT DOCUMENTS.** The Contract Documents consist of this Contractor's Agreement, the Conditions of the Contract (DFCM General Conditions, Supplementary and other Conditions), the Drawings, Specifications, Addenda and Modifications. The Contract Documents shall also include the bidding documents, including the Invitation to Bid, Instructions to Bidders/ Proposers and the Bid/Proposal, to the extent not in conflict therewith and other documents and oral presentations that are documented as an attachment to the contract.

All such documents are hereby incorporated by reference herein. Any reference in this Contractor's Agreement to certain provisions of the Contract Documents shall in no way be construed as to lessen the importance or applicability of any other provisions of the Contract Documents.

**ARTICLE 5. PAYMENT.** The DFCM agrees to pay the Contractor from time to time as the Work progresses, but not more than once each month after the date of Notice to Proceed, and only upon Certificate of the A/E for Work performed during the preceding calendar month, ninety-five percent (95%) of the value of the labor performed and ninety-five percent (95%) of the value of materials furnished in place or on the site. The Contractor agrees to furnish to the DFCM invoices for materials purchased and on the site but not installed, for which the Contractor requests payment and agrees to

safeguard and protect such equipment or materials and is responsible for safekeeping thereof and if such be stolen, lost or destroyed, to replace same.

Such evidence of labor performed and materials furnished as the DFCM may reasonably require shall be supplied by the Contractor at the time of request for Certificate of Payment on account. Materials for which payment has been made cannot be removed from the job site without DFCM's written approval. Five percent (5%) of the earned amount shall be retained from each monthly payment. The retainage, including any additional retainage imposed and the release of any retainage, shall be in accordance with UCA 13-8-5 as amended. Contractor shall also comply with the requirements of UCA 13-8-5, including restrictions of retainage regarding subcontractors and the distribution of interest earned on the retention proceeds. The DFCM shall not be responsible for enforcing the Contractor's obligations under State law in fulfilling the retention law requirements with subcontractors at any tier.

**ARTICLE 6. INDEBTEDNESS.** Before final payment is made, the Contractor must submit evidence satisfactory to the DFCM that all payrolls, materials bills, subcontracts at any tier and outstanding indebtedness in connection with the Work have been properly paid. Final Payment will be made after receipt of said evidence, final acceptance of the Work by the DFCM as well as compliance with the applicable provisions of the General Conditions.

Contractor shall respond immediately to any inquiry in writing by DFCM as to any concern of financial responsibility and DFCM reserves the right to request any waivers, releases or bonds from Contractor in regard to any rights of Subcontractors (including suppliers) at any tier or any third parties prior to any payment by DFCM to Contractor.

**ARTICLE 7. ADDITIONAL WORK.** It is understood and agreed by the parties hereto that no money will be paid to the Contractor for additional labor or materials furnished unless a new contract in writing or a Modification hereof in accordance with the General Conditions and the Contract Documents for such additional labor or materials has been executed. The DFCM specifically reserves the right to modify or amend this Contractor's Agreement and the total sum due hereunder either by enlarging or restricting the scope of the Work.

**ARTICLE 8. INSPECTIONS.** The Work shall be inspected for acceptance in accordance with the General Conditions.

**ARTICLE 9. DISPUTES.** Any dispute, PRE or Claim between the parties shall be subject to the provisions of Article 7 of the General Conditions. DFCM reserves all rights to pursue its rights and remedies as provided in the General Conditions.

**ARTICLE 10. TERMINATION, SUSPENSION OR ABANDONMENT.** This Contractor's Agreement may be terminated, suspended or abandoned in accordance with the General Conditions.

**ARTICLE 11. DFCM'S RIGHT TO WITHHOLD CERTAIN AMOUNT AND MAKE USE THEREOF.** The DFCM may withhold from payment to the Contractor such amount as, in DFCM's judgment, may be necessary to pay just claims against the Contractor or Subcontractor at any tier for labor and services rendered and materials furnished in and about the Work. The DFCM may apply such withheld amounts for the payment of such claims in DFCM's discretion. In so doing, the DFCM shall be deemed the agent of Contractor and payment so made by the DFCM shall be considered as payment made under this Contractor's Agreement by the DFCM to the Contractor. DFCM shall not be liable to the Contractor for any such payment made in good faith. Such withholdings and payments may be made without prior approval of the Contractor and may be also be prior to any determination as a result of any dispute, PRE, Claim or litigation.

**ARTICLE 12. INDEMNIFICATION.** The Contractor shall comply with the indemnification provisions of the General Conditions.

**ARTICLE 13. SUCCESSORS AND ASSIGNMENT OF CONTRACT.** The DFCM and Contractor, respectively bind themselves, their partners, successors, assigns and legal representatives to the other party to this Agreement, and to partners, successors, assigns and legal representatives of such other party with respect to all covenants, provisions, rights and responsibilities of this Contractor's Agreement. The Contractor shall not assign this Contractor's Agreement without the prior written consent of the DFCM, nor shall the Contractor assign any moneys due or to become due as well as any rights under this Contractor's Agreement, without prior written consent of the DFCM.

**ARTICLE 14. RELATIONSHIP OF THE PARTIES.** The Contractor accepts the relationship of trust and confidence established by this Contractor's Agreement and covenants with the DFCM to cooperate with the DFCM and A/E and use the Contractor's best skill, efforts and judgment in furthering the interest of the DFCM; to furnish efficient business administration and supervision; to make best efforts to furnish at all times an adequate supply of workers and materials; and to perform the Work in the best and most expeditious and economic manner consistent with the interests of the DFCM.

**ARTICLE 15. AUTHORITY TO EXECUTE AND PERFORM AGREEMENT.** Contractor and DFCM each represent that the execution of this Contractor's Agreement and the performance thereunder is within their respective duly authorized powers.

**ARTICLE 16. ATTORNEY FEES AND COSTS.** Except as otherwise provided in the dispute resolution provisions of the General Conditions, the prevailing party shall be entitled to reasonable attorney fees and costs incurred in any action in the District Court and/or appellate body to enforce this Contractor's Agreement or recover damages or any other action as a result of a breach thereof.

CONTRACTOR'S AGREEMENT  
PAGE NO. 5

**IN WITNESS WHEREOF**, the parties hereto have executed this Contractor's Agreement on the day and year stated hereinabove.

**CONTRACTOR:** \_\_\_\_\_

\_\_\_\_\_  
Signature Date

Title: \_\_\_\_\_

State of \_\_\_\_\_)  
\_\_\_\_\_)  
County of \_\_\_\_\_)

\_\_\_\_\_  
Please type/print name clearly

On this \_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, personally appeared before me, \_\_\_\_\_, whose identity is personally known to me (or proved to me on the basis of satisfactory evidence) and who by me duly sworn (or affirmed), did say that he (she) is the \_\_\_\_\_ (title or office) of the firm and that said document was signed by him (her) in behalf of said firm.

(SEAL)

\_\_\_\_\_  
**Notary Public**

My Commission Expires \_\_\_\_\_

APPROVED AS TO AVAILABILITY  
OF FUNDS:

\_\_\_\_\_  
David D. Williams, Jr. Date  
DFCM Administrative Services Director

**DIVISION OF FACILITIES  
CONSTRUCTION AND MANAGEMENT**

\_\_\_\_\_  
\_\_\_\_\_- Manager Date  
Capital Development/Improvements

APPROVED AS TO FORM:  
ATTORNEY GENERAL  
November 30, 2006  
By: Alan S. Bachman  
Asst Attorney General

APPROVED FOR EXPENDITURE:

\_\_\_\_\_  
Division of Finance Date

# PERFORMANCE BOND

(Title 63, Chapter 56, U. C. A. 1953, as Amended)

That \_\_\_\_\_ hereinafter referred to as the "Principal" and \_\_\_\_\_, a corporation organized and existing under the laws of the State of \_\_\_\_\_, with its principal office in the City of \_\_\_\_\_ and authorized to transact business in this State and U. S. Department of the Treasury Listed (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); hereinafter referred to as the "Surety," are held and firmly bound unto the State of Utah, hereinafter referred to as the "Obligee," in the amount of \_\_\_\_\_ DOLLARS (\$ \_\_\_\_\_) for the payment whereof, the said Principal and Surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

**WHEREAS**, the Principal has entered into a certain written Contract with the Obligee, dated the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, to construct \_\_\_\_\_ in the County of \_\_\_\_\_, State of Utah, Project No. \_\_\_\_\_, for the approximate sum of \_\_\_\_\_ Dollars (\$ \_\_\_\_\_), which Contract is hereby incorporated by reference herein.

**NOW, THEREFORE**, the condition of this obligation is such that if the said Principal shall faithfully perform the Contract in accordance with the Contract Documents including, but not limited to, the Plans, Specifications and conditions thereof, the one year performance warranty, and the terms of the Contract as said Contract may be subject to Modifications or changes, then this obligation shall be void; otherwise it shall remain in full force and effect.

No right of action shall accrue on this bond to or for the use of any person or corporation other than the state named herein or the heirs, executors, administrators or successors of the Owner.

The parties agree that the dispute provisions provided in the Contract Documents apply and shall constitute the sole dispute procedures of the parties.

**PROVIDED, HOWEVER**, that this Bond is executed pursuant to the Provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on this Bond shall be determined in accordance with said provisions to the same extent as if it were copied at length herein.

**IN WITNESS WHEREOF**, the said Principal and Surety have signed and sealed this instrument this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

**WITNESS OR ATTESTATION:**

**PRINCIPAL:**

\_\_\_\_\_

\_\_\_\_\_

By: \_\_\_\_\_ (Seal)

Title: \_\_\_\_\_

**WITNESS OR ATTESTATION:**

**SURETY:**

\_\_\_\_\_

\_\_\_\_\_

By: \_\_\_\_\_ Attorney-in-Fact (Seal)

STATE OF \_\_\_\_\_ )  
 ) ss.  
COUNTY OF \_\_\_\_\_ )

On this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, personally appeared before me \_\_\_\_\_, whose identity is personally known to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney in-fact of the above-named Surety Company and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

My commission expires: \_\_\_\_\_

Resides at: \_\_\_\_\_

\_\_\_\_\_  
NOTARY PUBLIC

Agency: \_\_\_\_\_  
Agent: \_\_\_\_\_  
Address: \_\_\_\_\_  
Phone: \_\_\_\_\_

Approved As To Form: May 25, 2005  
By Alan S. Bachman, Asst Attorney General

# PAYMENT BOND

(Title 63, Chapter 56, U. C. A. 1953, as Amended)

## KNOW ALL PERSONS BY THESE PRESENTS:

That \_\_\_\_\_ hereinafter referred to as the "Principal," and \_\_\_\_\_, a corporation organized and existing under the laws of the State of \_\_\_\_\_ authorized to do business in this State and U. S. Department of the Treasury Listed (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); with its principal office in the City of \_\_\_\_\_, hereinafter referred to as the "Surety," are held and firmly bound unto the State of Utah hereinafter referred to as the "Obligee," in the amount of \_\_\_\_\_ Dollars (\$ \_\_\_\_\_) for the payment whereof, the said Principal and Surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

**WHEREAS**, the Principal has entered into a certain written Contract with the Obligee, dated the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, to construct \_\_\_\_\_ in the County of \_\_\_\_\_, State of Utah, Project No. \_\_\_\_\_ for the approximate sum of \_\_\_\_\_ Dollars (\$ \_\_\_\_\_), which contract is hereby incorporated by reference herein.

**NOW, THEREFORE**, the condition of this obligation is such that if the said Principal shall pay all claimants supplying labor or materials to Principal or Principal's Subcontractors in compliance with the provisions of Title 63, Chapter 56, of Utah Code Annotated, 1953, as amended, and in the prosecution of the Work provided for in said Contract, then, this obligation shall be void; otherwise it shall remain in full force and effect.

That said Surety to this Bond, for value received, hereby stipulates and agrees that no changes, extensions of time, alterations or additions to the terms of the Contract or to the Work to be performed thereunder, or the specifications or drawings accompanying same shall in any way affect its obligation on this Bond, and does hereby waive notice of any such changes, extensions of time, alterations or additions to the terms of the Contract or to the Work or to the specifications or drawings and agrees that they shall become part of the Contract Documents.

**PROVIDED, HOWEVER**, that this Bond is executed pursuant to the provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on this Bond shall be determined in accordance with said provisions to the same extent as if it were copied at length herein.

**IN WITNESS WHEREOF**, the said Principal and Surety have signed and sealed this instrument this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

## WITNESS OR ATTESTATION:

## PRINCIPAL:

\_\_\_\_\_

\_\_\_\_\_

By: \_\_\_\_\_  
(Seal)

Title: \_\_\_\_\_

## WITNESS OR ATTESTATION:

## SURETY:

\_\_\_\_\_

\_\_\_\_\_

By: \_\_\_\_\_  
Attorney-in-Fact (Seal)

STATE OF \_\_\_\_\_ )  
 ) ss.  
COUNTY OF \_\_\_\_\_ )

On this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, personally appeared before me \_\_\_\_\_, whose identity is personally known to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney-in-fact of the above-named Surety Company, and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

My commission expires: \_\_\_\_\_

Resides at: \_\_\_\_\_

NOTARY PUBLIC

**Agency:** \_\_\_\_\_  
**Agent:** \_\_\_\_\_  
**Address:** \_\_\_\_\_  
**Phone:** \_\_\_\_\_

Approved As To Form: May 25, 2005  
By Alan S. Bachman, Asst Attorney General

**CERTIFICATE OF SUBSTANTIAL COMPLETION**

PROJECT \_\_\_\_\_ PROJECT NO: \_\_\_\_\_  
AGENCY/INSTITUTION \_\_\_\_\_

AREA ACCEPTED \_\_\_\_\_

The Work performed under the subject Contract has been reviewed on this date and found to be Substantially Completed as defined in the General Conditions; including that the construction is sufficiently completed in accordance with the Contract Documents, as modified by any change orders agreed to by the parties, so that the State of Utah can occupy the Project or specified area of the Project for the use for which it is intended.

The DFCM - (Owner) accepts the Project or specified area of the Project as Substantially Complete and will assume full possession of the Project or specified area of the Project at \_\_\_\_\_ (time) on \_\_\_\_\_ (date).

The DFCM accepts the Project for occupancy and agrees to assume full responsibility for maintenance and operation, including utilities and insurance, of the Project subject to the itemized responsibilities and/or exceptions noted below:

\_\_\_\_\_

\_\_\_\_\_

The Owner acknowledges receipt of the following closeout and transition materials:

As-built Drawings

O & M Manuals

Warranty Documents

Completion of Training  
Requirements

A list of items to be completed or corrected (Punch List) is attached hereto. The failure to include an item on it does not alter the responsibility of the Contractor to complete all the Work in accordance with the Contract Documents, including authorized changes thereof. The amount of \_\_\_\_\_ (Twice the value of the punch list work) shall be retained to assure the completion of the punch list work.

The Contractor shall complete or correct the Work on the list of (Punch List) items appended hereto within \_\_\_\_\_ calendar days from the above date of issuance of this Certificate. The amount withheld pending completion of the list of items noted and agreed to shall be: \$ \_\_\_\_\_. If the list of items is not completed within the time allotted the Owner has the right to be compensated for the delays and/or complete the work with the help of independent contractor at the expense of the retained project funds. If the retained project funds are insufficient to cover the delay/completion damages, the Owner shall be promptly reimbursed for the balance of the funds needed to compensate the Owner.

\_\_\_\_\_  
CONTRACTOR (include name of firm) by: \_\_\_\_\_  
(Signature) DATE

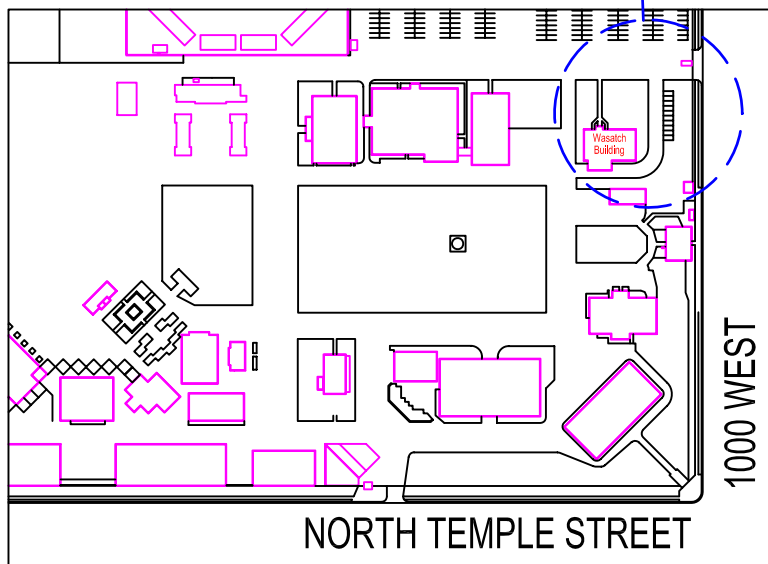
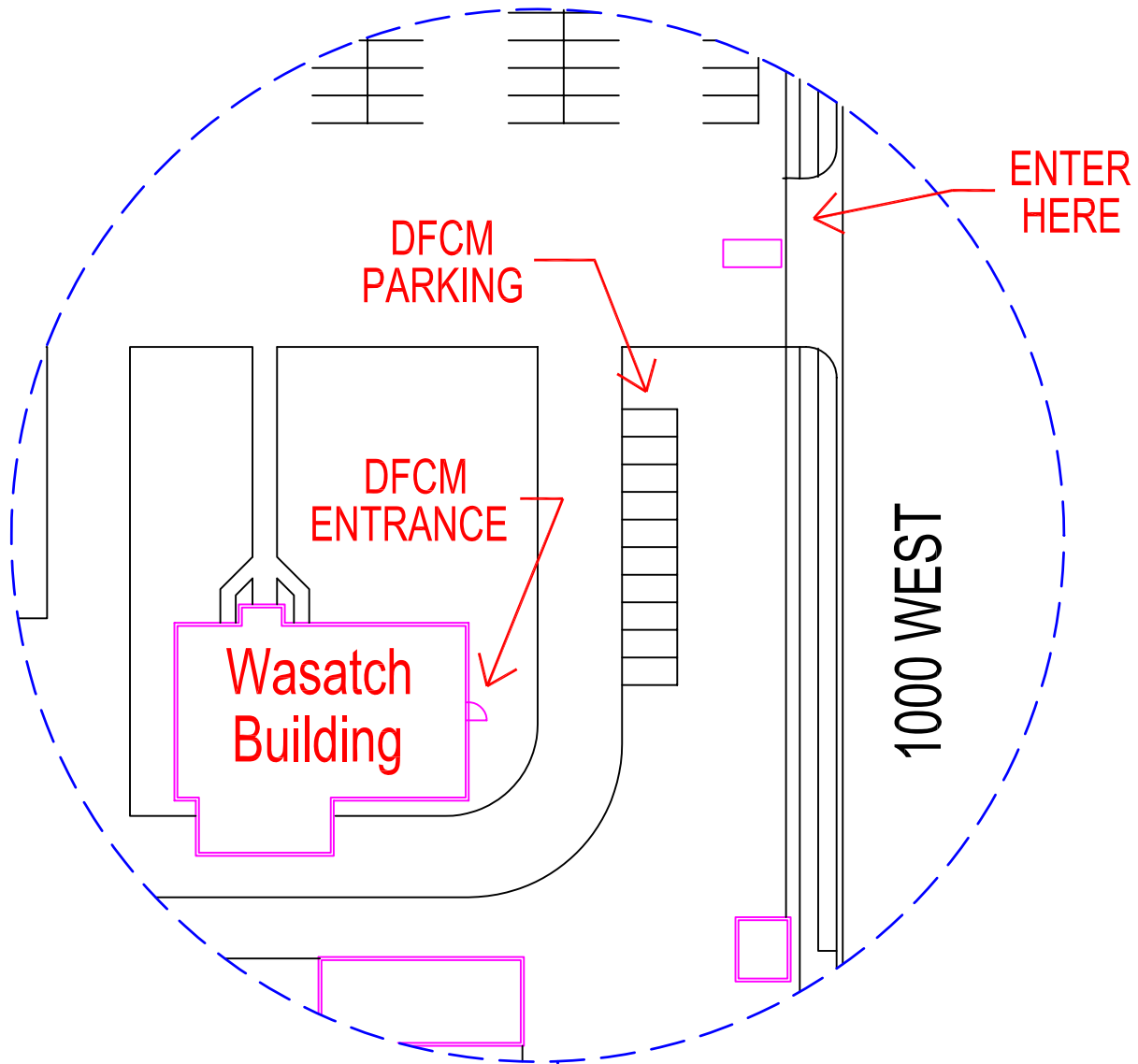
\_\_\_\_\_  
A/E (include name of firm) by: \_\_\_\_\_  
(Signature) DATE

\_\_\_\_\_  
USING INSTITUTION OR AGENCY by: \_\_\_\_\_  
(Signature) DATE

\_\_\_\_\_  
DFCM (Owner) by: \_\_\_\_\_  
(Signature) DATE

4110 State Office Building, Salt Lake City, Utah 84114 cc:  
telephone 801-538-3018 • facsimile 801-538-3267 • <http://dfcm.utah.gov>

Parties Noted  
DFCM, Director



UTAH STATE  
FAIR PARK



DFCM Temporary Location

# **DEPARTMENT OF NATURAL RESOURCES OIL, GAS AND MINING REMODEL**

**DFCM #07262500**



State of Utah—Department of Administrative Services

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## **DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT**

4110 State Office Building / Salt Lake City, Utah 84114 / 538-3018

# **SPECIFICATIONS**

**PREPARED BY**

**WHW ENGINEERING INC.  
1354 EAST 3300 SOUTH, SUITE 200  
SALT LAKE CITY, UTAH 84106  
PHONE: (801) 466-4021  
FAX: (801) 466-8536**

**May 2007**

**WHW Engineering Project # 07017**

## **DIVISION 1 – GENERAL REQUIREMENTS**

|       |                                     |
|-------|-------------------------------------|
| 01100 | SUMMARY                             |
| 01250 | CONTRACT MODIFICATION PROCEDURES    |
| 01290 | PAYMENT PROCEDURES                  |
| 01310 | PROJECT MANAGEMENT AND COORDINATION |
| 01400 | QUALITY REQUIREMENTS                |
| 01600 | PRODUCT REQUIREMENTS                |
| 01700 | EXECUTION REQUIREMENTS              |
| 01732 | SELECTIVE DEMOLITION                |
| 01770 | CLOSEOUT PROCEDURES                 |
| 01781 | PROJECT RECORD DOCUMENTS            |
| 01782 | OPERATION AND MAINTENANCE DATA      |
| 01820 | DEMONSTRATION AND TRAINING          |

## **DIVISION 6- WOOD AND PLASTICS**

|       |                                 |
|-------|---------------------------------|
| 06402 | INTERIOR ARCHITECTURAL WOODWORK |
|-------|---------------------------------|

## **DIVISION 8 – DOORS AND WINDOWS**

|       |                                    |
|-------|------------------------------------|
| 08110 | STEEL DOORS AND FRAMES             |
| 08211 | FLUSH WOOD DOORS                   |
| 08410 | ALUMINUM ENTRANCES AND STOREFRONTS |
| 08520 | ALUMINUM WINDOWS                   |
| 08710 | DOOR HARDWARE                      |

## **DIVISION 9 - FINISHES**

|       |                                     |
|-------|-------------------------------------|
| 09111 | NON-LOAD BEARING STEEL FRAMING      |
| 09250 | GYPSUM BOARD                        |
| 09510 | ACOUSTIC CEILINGS                   |
| 09653 | RESILIENT WALL BASE AND ACCESSORIES |
| 09680 | SHEET CARETING                      |
| 09912 | INTERIOR PAINTING                   |

## **DIVISION 12 - FURNISHINGS**

|       |                          |
|-------|--------------------------|
| 12491 | HORIZONTAL LOUVER BLINDS |
|-------|--------------------------|

## **DIVISION 15 - MECHANICAL**

|       |                           |
|-------|---------------------------|
| 15010 | GENERAL REQUIREMENTS      |
| 15050 | BASIC MATERIALS & METHODS |
| 15075 | MECHANICAL IDENTIFICATION |
| 15083 | HVAC INSULATION           |
| 15815 | METAL DUCTS               |
| 15820 | DUCT ACCESSORIES          |
| 15840 | AIR TERMINAL UNITS        |

|       |                                   |
|-------|-----------------------------------|
| 15855 | DIFFUSERS, REGISTERS, AND GRILLES |
| 15900 | HVAC INSTRUMENTATION AND CONTROLS |
| 15950 | TESTING, ADJUSTING AND BALANCING  |

**DIVISION 16000 - ELECTRICAL**

|       |  |
|-------|--|
| 16051 | COMMON WORK RESULTS FOR ELECTRICAL                     |
| 16053 | COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY |
| 16074 | VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS  |
| 16120 | CONDUCTORS AND CABLES                                  |
| 16130 | RACEWAYS AND BOXES                                     |

## **DIVISION 1 - GENERAL REQUIREMENTS**

|       |                                     |
|-------|-------------------------------------|
| 01100 | SUMMARY                             |
| 01250 | CONTRACT MODIFICATION PROCEDURES    |
| 01290 | PAYMENT PROCEDURES                  |
| 01310 | PROJECT MANAGEMENT AND COORDINATION |
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## **DIVISION 6- WOOD AND PLASTICS**

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## **DIVISION 9 - FINISHES**

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## **DIVISION 12 - FURNISHINGS**

|       |                          |
|-------|--------------------------|
| 12491 | HORIZONTAL LOUVER BLINDS |
|-------|--------------------------|

## SECTION 01100 - SUMMARY

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Work covered by the Contract Documents.
  - 4. Use of premises.
  - 5. Owner's occupancy requirements.
  - 6. Specification formats and conventions.

#### 1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Identification: Dept. of Natural Resources Bldg. Interior Remodel
  - 1. Project Location: 1594 West North Temple, Salt Lake City, Utah
- B. Owner: Utah Department of Facilities and Construction Management
  - 1. Owner's Representative:
- C. Architect: Eaton Architecture, Inc.
- D. The Work consists of the following:
  - 1. The Work includes the demolition of existing selected partitions, doors and frames, flooring, ceilings, HVAC items and lighting. The installation of new partitions, doors and frames, flooring, ceilings, HVAC items, lighting and windows.
- E. Project will be constructed under a single prime contract.

#### 1.5 USE OF PREMISES

- C. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
  - 2. Owner Occupancy: Allow for Owner occupancy of Project site and use by the public.
  - 3. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
    - a. Schedule deliveries to minimize use of driveways and entrances.

- b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- D. Use of Existing Building: Maintain existing building in a weathertight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.

#### 1.6 OWNER'S OCCUPANCY REQUIREMENTS

- B. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits, unless otherwise indicated.
  - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.

#### 1.7 SPECIFICATION FORMATS AND CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 16-division format and CSI/CSC's "MasterFormat" numbering system.
  - 1. Division 1: Sections in Division 1 govern the execution of the Work of all Sections in the Specifications.
- B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
  - 1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
  - 2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
    - a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

END OF SECTION 01100

## SECTION 01250 - CONTRACT MODIFICATION PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.

#### 1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

#### 1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
  - 1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
  - 2. Within 20 days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    - c. Include costs of labor and supervision directly attributable to the change.
    - d. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
- B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to Architect.
  - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.

2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
  3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
  4. Include costs of labor and supervision directly attributable to the change.
  5. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
  6. Comply with requirements in Division 1 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.
- C. Proposal Request Form: Use AIA Document G709 for Proposal Requests.

#### 1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01250

## SECTION 01290 - PAYMENT PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

#### 1.2 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule. Cost-loaded CPM Schedule may serve to satisfy requirements for the Schedule of Values.
  - 1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including Application for Payment forms with Continuation Sheets and Contractor's Construction Schedule.
  - 2. Submit the Schedule of Values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
  - 3. Subschedules: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values correlated with each phase of payment.
- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.
  - 1. Identification: Include the following Project identification on the Schedule of Values:
    - a. Project name and location.
    - b. Name of Architect.
    - c. Architect's project number.
    - d. Contractor's name and address.
    - e. Date of submittal.
  - 2. Submit draft of AIA Document G703 Continuation Sheets.
  - 3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate. Include separate line items under required principal subcontracts for operation and maintenance manuals, punch list activities, Project Record Documents, and demonstration and training in the amount of 5 percent of the Contract Sum.
  - 4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.

5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
  - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.
9. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

### 1.3 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
  1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Progress payments shall be submitted to Architect by the 15th of the month. The period covered by each Application for Payment is one month, ending on the last day of the previous month.
- D. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
  1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
  2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- F. Transmittal: Submit 3 signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
  2. When an application shows completion of an item, submit final or full waivers.
  3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
  4. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
  2. Schedule of Values.
  3. Contractor's Construction Schedule (preliminary if not final).
  4. Schedule of unit prices.
  5. Submittals Schedule (preliminary if not final).
  6. List of Contractor's staff assignments.
  7. List of Contractor's principal consultants.
  8. Copies of building permits.
  9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  10. Initial progress report.
  11. Report of preconstruction conference.
  12. Certificates of insurance and insurance policies.
- I. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
  2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
  2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.

3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final, liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01290

## SECTION 01310 - PROJECT MANAGEMENT AND COORDINATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. Coordination Drawings.
  - 2. Project meetings.
  - 3. Requests for Interpretation (RFIs).
- C. See Division 1 Section "Execution Requirements" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

#### 1.2 DEFINITIONS

- A. RFI: Request from Contractor seeking interpretation or clarification of the Contract Documents.

#### 1.3 COORDINATION

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
  - 4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
  1. Preparation of Contractor's Construction Schedule.
  2. Preparation of the Schedule of Values.
  3. Installation and removal of temporary facilities and controls.
  4. Delivery and processing of submittals.
  5. Progress meetings.
  6. Preinstallation conferences.
  7. Project closeout activities.
  8. Startup and adjustment of systems.
  9. Project closeout activities.

#### 1.4 SUBMITTALS

- A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
  1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:
    - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    - b. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
  2. Sheet Size: At least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 40 inches (750 by 1000 mm).
  3. Number of Copies: Submit three opaque copies of each submittal. Architect will return one copy.
  4. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

#### 1.5 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
  - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
  - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  - 3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
  - 1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 2. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Tentative construction schedule.
    - b. Phasing.
    - c. Critical work sequencing and long-lead items.
    - d. Designation of key personnel and their duties.
    - e. Procedures for processing field decisions and Change Orders.
    - f. Procedures for RFIs.
    - g. Procedures for testing and inspecting.
    - h. Procedures for processing Applications for Payment.
    - i. Distribution of the Contract Documents.
    - j. Submittal procedures.
    - k. LEED requirements.
    - l. Preparation of Record Documents.
    - m. Use of the premises and existing building.
    - n. Work restrictions.
    - o. Owner's occupancy requirements.
    - p. Responsibility for temporary facilities and controls.
    - q. Construction waste management and recycling.
    - r. Parking availability.
    - s. Office, work, and storage areas.
    - t. Equipment deliveries and priorities.
    - u. First aid.
    - v. Security.
    - w. Progress cleaning.
    - x. Working hours.
  - 3. Minutes: Architect will record and distribute meeting minutes.

- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
  2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    - a. The Contract Documents.
    - b. Options.
    - c. Related RFIs.
    - d. Related Change Orders.
    - e. Purchases.
    - f. Deliveries.
    - g. Submittals.
    - h. Review of mockups.
    - i. Possible conflicts.
    - j. Compatibility problems.
    - k. Time schedules.
    - l. Weather limitations.
    - m. Manufacturer's written recommendations.
    - n. Warranty requirements.
    - o. Compatibility of materials.
    - p. Acceptability of substrates.
    - q. Temporary facilities and controls.
    - r. Space and access limitations.
    - s. Regulations of authorities having jurisdiction.
    - t. Testing and inspecting requirements.
    - u. Installation procedures.
    - v. Coordination with other work.
    - w. Required performance results.
    - x. Protection of adjacent work.
    - y. Protection of construction and personnel.
  3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
  4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
  5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at weekly intervals. Coordinate dates of meetings with preparation of payment requests.

1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
  - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    - 1) Review schedule for next period.
  - b. Review present and future needs of each entity present, including the following:
    - 1) Interface requirements.
    - 2) Sequence of operations.
    - 3) Status of submittals.
    - 4) Deliveries.
    - 5) Off-site fabrication.
    - 6) Access.
    - 7) Site utilization.
    - 8) Temporary facilities and controls.
    - 9) Work hours.
    - 10) Hazards and risks.
    - 11) Progress cleaning.
    - 12) Quality and work standards.
    - 13) Status of correction of deficient items.
    - 14) Field observations.
    - 15) RFIs.
    - 16) Status of proposal requests.
    - 17) Pending changes.
    - 18) Status of Change Orders.
    - 19) Pending claims and disputes.
    - 20) Documentation of information for payment requests.
3. Minutes: Architect will record and distribute to Contractor the meeting minutes.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
  - a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

## 1.6 REQUESTS FOR INTERPRETATION (RFIs)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.
  - 1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
  - 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
  - 1. Project name.
  - 2. Date.
  - 3. Name of Contractor.
  - 4. Name of Architect.
  - 5. RFI number, numbered sequentially.
  - 6. Specification Section number and title and related paragraphs, as appropriate.
  - 7. Drawing number and detail references, as appropriate.
  - 8. Field dimensions and conditions, as appropriate.
  - 9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  - 10. Contractor's signature.
  - 11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
- C. Hard-Copy RFIs: CSI Form 13.2A.
  - 1. Identify each page of attachments with the RFI number and sequential page number.
- D. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow seven working days for Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.
  - 1. The following RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for coordination information already indicated in the Contract Documents.
    - d. Requests for adjustments in the Contract Time or the Contract Sum.
    - e. Requests for interpretation of Architect's actions on submittals.
    - f. Incomplete RFIs or RFIs with numerous errors.
  - 2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.

3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 1 Section "Contract Modifications."
  - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- E. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
- F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log bi-weekly. Use CSI Log Form 13.2B.
  1. Project name.
  2. Name and address of Contractor.
  3. Name and address of Architect.
  4. RFI number including RFIs that were dropped and not submitted.
  5. RFI description.
  6. Date the RFI was submitted.
  7. Date Architect's response was received.
  8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
  9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01310

## SECTION 01400 - QUALITY REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
  - 2. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. See Divisions 2 through 16 Sections for specific test and inspection requirements.

#### 1.2 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- E. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
- F. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.
- G. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

- H. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- I. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- J. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
  - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.
- K. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

### 1.3 CONFLICTING REQUIREMENTS

- A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

### 1.4 SUBMITTALS

- A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. Reports: Prepare and submit certified written reports that include the following:
  - 1. Date of issue.
  - 2. Project title and number.
  - 3. Name, address, and telephone number of testing agency.
  - 4. Dates and locations of samples and tests or inspections.
  - 5. Names of individuals making tests and inspections.

6. Description of the Work and test and inspection method.
  7. Identification of product and Specification Section.
  8. Complete test or inspection data.
  9. Test and inspection results and an interpretation of test results.
  10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
  11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  12. Name and signature of laboratory inspector.
  13. Recommendations on retesting and reinspecting.
- C. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

## 1.5 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.
- F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirement for specialists shall not supersede building codes and regulations governing the Work.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according

to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
  2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
  2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
  3. Demonstrate the proposed range of aesthetic effects and workmanship.
  4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
  5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  6. Demolish and remove mockups when directed, unless otherwise indicated.
- J. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Sections in Divisions 2 through 16.

## 1.6 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
  2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
- B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

- a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
  3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 1 Section "Submittal Procedures."
- D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- E. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
  3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
  4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  6. Do not perform any duties of Contractor.
- F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.
  3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
  4. Facilities for storage and field curing of test samples.
  5. Delivery of samples to testing agencies.

6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  7. Security and protection for samples and for testing and inspecting equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
  2. Comply with the Contract Document requirements for Division 1 Section "Cutting and Patching."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01400

## SECTION 01600 - PRODUCT REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. See Division 1 Section "Closeout Procedures" for submitting warranties for Contract closeout.
- C. See Divisions 2 through 16 Sections for specific requirements for warranties on products and installations specified to be warranted.

#### 1.2 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
  - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

#### 1.3 SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Substitution Request Form: Use CSI Form 13.1A.
  2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified material or product cannot be provided.
    - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
    - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
    - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    - e. Samples, where applicable or requested.
    - f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
    - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
    - h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
    - i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
    - j. Cost information, including a proposal of change, if any, in the Contract Sum.
    - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
    - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
  3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
    - a. Form of Acceptance: Change Order.
    - b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.

- B. Comparable Product Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
    - a. Form of Approval: As specified in Division 1 Section "Submittal Procedures."
    - b. Use product specified if Architect cannot make a decision on use of a comparable product request within time allocated.
- C. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 1 Section "Submittal Procedures." Show compliance with requirements.

#### 1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

#### 1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
  - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
  - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
  - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
  - 4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
- C. Storage:
  - 1. Store products to allow for inspection and measurement of quantity or counting of units.
  - 2. Store materials in a manner that will not endanger Project structure.
  - 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.

4. Store cementitious products and materials on elevated platforms.
5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.

## 1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
  1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
  2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
  1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
  3. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 1 Section "Closeout Procedures."

## PART 2 - PRODUCTS

### 2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
  1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.

3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

B. Product Selection Procedures:

1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.
8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.
9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
  - a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.
10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.

- a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
- b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

## 2.2 PRODUCT SUBSTITUTIONS

- A. Timing: Architect will consider requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.
- B. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
  - 1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
  - 2. Requested substitution does not require extensive revisions to the Contract Documents.
  - 3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
  - 4. Substitution request is fully documented and properly submitted.
  - 5. Requested substitution will not adversely affect Contractor's Construction Schedule.
  - 6. Requested substitution has received necessary approvals of authorities having jurisdiction.
  - 7. Requested substitution is compatible with other portions of the Work.
  - 8. Requested substitution has been coordinated with other portions of the Work.
  - 9. Requested substitution provides specified warranty.

## 2.3 COMPARABLE PRODUCTS

- A. Conditions: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
  - 1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
  - 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01600

## SECTION 01700 - EXECUTION REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
  - 3. General installation of products.
  - 4. Progress cleaning.
  - 5. Starting and adjusting.
  - 6. Protection of installed construction.
  - 7. Correction of the Work.
- B. See Division 1 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

#### 1.2 SUBMITTALS

- B. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

### PART 2 - PRODUCTS (Not Used)

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
- C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
  - 1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
  - 2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.

3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Existing Utility Information: Furnish information to **[local utility]** **[Owner]** that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents. Submit requests on CSI Form 13.2A, "Request for Interpretation."

### 3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

### 3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  1. Make vertical work plumb and make horizontal work level.
  2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.

- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
  - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
  - 2. Allow for building movement, including thermal expansion and contraction.
  - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

### 3.6 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
  - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  - 2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F (27 deg C).
  - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
  - 1. Remove liquid spills promptly.
  - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

### 3.7 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 1 Section "Quality Requirements."

### 3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

### 3.9 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 1 Section "Cutting and Patching."
  - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01700

## SECTION 01732 - SELECTIVE DEMOLITION

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. This Section includes the following:

1. Demolition and removal of selected portions of building or structure.
3. Salvage of existing items to be reused or recycled.

#### 1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

#### 1.3 SUBMITTALS

- A. Schedule of Selective Demolition Activities: Indicate detailed sequence of selective demolition and removal work, with starting and ending dates for each activity, interruption of utility services, use of elevator and stairs, and locations of temporary partitions and means of egress.
- B. Predemolition Photographs or Videotapes: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Comply with Division 1 Section "Photographic Documentation." Submit before Work begins.
- C. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
1. Comply with submittal requirements in Division 1 Section "Construction Waste Management."

#### 1.4 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.
- C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Standards: Comply with ANSI A10.6 and NFPA 241.
- E. Predemolition Conference: Conduct conference at Project site.

#### 1.5 PROJECT CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
  - 1. Before selective demolition, Owner will remove the following items:
    - a. Furniture, fixtures and equipment.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
  - 2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.
- G. Storage or sale of removed items or materials on-site is not permitted.
- H. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  - 1. Maintain fire-protection facilities in service during selective demolition operations.

#### 1.6 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.
- F. Survey of Existing Conditions: Record existing conditions by use of measured drawings.
  - 1. Comply with requirements specified in Division 1 Section "Photographic Documentation."
- G. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

### 3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
- B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. Arrange to shut off indicated utilities with utility companies.
  - 2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass

area of selective demolition and that maintain continuity of services/systems to other parts of building.

3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

### 3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
  1. Comply with requirements for access and protection specified in Division 1 Section "Temporary Facilities and Controls."
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

### 3.4 SELECTIVE DEMOLITION

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
  1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
  2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
  4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
  5. Dispose of demolished items and materials promptly.
- B. Reuse of Building Elements: Project has been designed to result in end-of-Project rates for reuse of building elements as follows. Do not demolish building elements beyond what is indicated on Drawings without Architect's approval.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Comply with requirements specified in Division 1 Section "Construction Waste Management."

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 01732

## SECTION 01770 - CLOSEOUT PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
  - 1. Inspection procedures.
  - 2. Warranties.
  - 3. Final cleaning.
- B. See Division 1 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
- D. See Division 1 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
- E. See Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
- F. See Division 1 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
- G. See Divisions 2 through 16 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

#### 1.2 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
  - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
  - 2. Advise Owner of pending insurance changeover requirements.
  - 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  - 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  - 5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.

6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
  7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  8. Complete startup testing of systems.
  9. Submit test/adjust/balance records.
  10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  11. Advise Owner of changeover in heat and other utilities.
  12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
  13. Complete final cleaning requirements, including touchup painting.
  14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
  2. Results of completed inspection will form the basis of requirements for Final Completion.

### 1.3 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
1. Submit a final Application for Payment according to Division 1 Section "Payment Procedures."
  2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  4. Submit pest-control final inspection report and warranty.
  5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

#### 1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use CSI Form 14.1A.
  1. Organize list of spaces in sequential order, starting with exterior areas first.
  2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

#### 1.5 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
  1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.
  2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
  3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- C. Provide additional copies of each warranty to include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

### PART 3 - EXECUTION

### 3.1 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
  - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
    - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    - h. Sweep concrete floors broom clean in unoccupied spaces.
    - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
    - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
    - k. Remove labels that are not permanent.
    - l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
      - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
    - m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
    - n. Replace parts subject to unusual operating conditions.
    - o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
    - p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

- q. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
  - r. Leave Project clean and ready for occupancy.
- C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.
- D. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 01770

## SECTION 01781 - PROJECT RECORD DOCUMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
  - 1. Record Drawings.
  - 2. Record Specifications.
  - 3. Record Product Data.
- B. See Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
- C. See Divisions 2 through 16 Sections for specific requirements for Project Record Documents of the Work in those Sections.

#### 1.2 SUBMITTALS

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit one set(s) of marked-up Record Prints.
- B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit three copies of each Product Data submittal.

### PART 2 - PRODUCTS

#### 2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
  - 1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.

- a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
  2. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
  3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- D. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  2. Record Transparencies: Organize into unbound sets matching Record Prints. Place transparencies in durable tube-type drawing containers with end caps. Mark end cap of each container with identification. If container does not include a complete set, identify Drawings included.
  3. Record CAD Drawings: Organize CAD information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each CAD file.
  4. Identification: As follows:
    - a. Project name.
    - b. Date.
    - c. Designation "PROJECT RECORD DRAWINGS."
    - d. Name of Architect.
    - e. Name of Contractor.

## 2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
  3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
  4. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

## 2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
  - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  - 3. Note related Change Orders[, **Record Specifications**,] and Record Drawings where applicable.

## 2.4 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

# PART 3 - EXECUTION

## 3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

END OF SECTION 01781

## SECTION 01782 - OPERATION AND MAINTENANCE DATA

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Emergency manuals.
  - 2. Operation manuals for systems, subsystems, and equipment.
  - 3. Maintenance manuals for the care and maintenance of systems and equipment.
- B. See Divisions 2 through 16 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

#### 1.2 SUBMITTALS

- A. Manual: Submit one copy of each manual in final form at least 15 days before final inspection. Architect will return copy with comments within 15 days after final inspection.
  - 1. Correct or modify each manual to comply with Architect's comments. Submit 3 copies of each corrected manual within 15 days of receipt of Architect's comments.

### PART 2 - PRODUCTS

#### 2.1 MANUALS, GENERAL

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain a title page, table of contents, and manual contents.
- B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
  - 1. Subject matter included in manual.
  - 2. Name and address of Project.
  - 3. Name and address of Owner.
  - 4. Date of submittal.
  - 5. Name, address, and telephone number of Contractor.
  - 6. Name and address of Architect.
  - 7. Cross-reference to related systems in other operation and maintenance manuals.

- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
  - 1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
    - a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
  - 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
  - 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
  - 4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
    - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

## 2.2 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for type of emergency, emergency instructions, and emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component for fire, flood, gas leak, water leak, power failure, water outage, equipment failure and chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

- D. Emergency Procedures: Include instructions on stopping, shutdown instructions for each type of emergency, operating instructions for conditions outside normal operating limits, and required sequences for electric or electronic systems.

## 2.3 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and equipment descriptions, operating standards, operating procedures, operating logs, wiring and control diagrams, and license requirements.
- B. Descriptions: Include the following:
  - 1. Product name and model number.
  - 2. Manufacturer's name.
  - 3. Equipment identification with serial number of each component.
  - 4. Equipment function.
  - 5. Operating characteristics.
  - 6. Limiting conditions.
  - 7. Performance curves.
  - 8. Engineering data and tests.
  - 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

## 2.4 PRODUCT MAINTENANCE MANUAL

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Product Information: Include the following, as applicable:
  - 1. Product name and model number.
  - 2. Manufacturer's name.

3. Color, pattern, and texture.
  4. Material and chemical composition.
  5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and inspection procedures, types of cleaning agents, methods of cleaning, schedule for cleaning and maintenance, and repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

## 2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment:
- D. Maintenance Procedures: Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions that detail essential maintenance procedures:
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

## PART 3 - EXECUTION

### 3.1 MANUAL PREPARATION

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
- D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
- E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
  - 1. Do not use original Project Record Documents as part of operation and maintenance manuals.
- F. Comply with Division 1 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01782

## SECTION 01820 - DEMONSTRATION AND TRAINING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
  - 1. Demonstration of operation of systems, subsystems, and equipment.
  - 2. Training in operation and maintenance of systems, subsystems, and equipment.
  - 3. Demonstration and training videotapes.
- B. See Divisions 2 through 16 Sections for specific requirements for demonstration and training for products in those Sections.

#### 1.2 SUBMITTALS

- A. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
- B. Demonstration and Training Videotapes: Submit two copies within seven days of end of each training module.

#### 1.3 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 1 Section "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Preinstruction Conference: Conduct conference at Project site. Review methods and procedures related to demonstration and training.
- D. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

## PART 2 - PRODUCTS

### 2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:
  - 1. Basis of System Design, Operational Requirements, and Criteria: Include system and equipment descriptions, operating standards, regulatory requirements, equipment function, operating characteristics, limiting conditions, and performance curves.
  - 2. Documentation: Review emergency, operations, and maintenance manuals; Project Record Documents; identification systems; warranties and bonds; and maintenance service agreements.
  - 3. Emergencies: Include instructions on stopping; shutdown instructions; operating instructions for conditions outside normal operating limits; instructions on meaning of warnings, trouble indications, and error messages; and required sequences for electric or electronic systems.
  - 4. Operations: Include startup, break-in, control, and safety procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; operating procedures for emergencies and equipment failure; and required sequences for electric or electronic systems.
  - 5. Adjustments: Include alignments and checking, noise, vibration, economy, and efficiency adjustments.
  - 6. Troubleshooting: Include diagnostic instructions and test and inspection procedures.
  - 7. Maintenance: Include inspection procedures, types of cleaning agents, methods of cleaning, procedures for preventive and routine maintenance, and instruction on use of special tools.
  - 8. Repairs: Include diagnosis, repair, and disassembly instructions; instructions for identifying parts; and review of spare parts needed for operation and maintenance.

## PART 3 - EXECUTION

### 3.1 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Owner will furnish an instructor to describe Owner's operational philosophy.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
  1. Schedule training with Owner with at least seven days' advance notice.
- D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

### 3.2 DEMONSTRATION AND TRAINING VIDEOTAPES

- A. General: Engage a qualified commercial photographer to record demonstration and training videotapes. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
  1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Videotape Format: Provide high-quality VHS color videotape in full-size cassettes.

END OF SECTION 01820

## SECTION 05400 - COLD-FORMED METAL FRAMING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
1. Exterior load-bearing wall framing.
  2. Interior load-bearing wall framing.
  3. Exterior non-load-bearing wall framing.
  4. Floor joist framing.
  5. Roof trusses.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
1. Design Loads: [**As indicated.**] [**As follows:**]
    - a. Dead Loads: [**Weights of materials and construction**] **<Insert applicable dead loads>**.
    - b. Live Loads: **<Insert applicable live loads.>**
    - c. Roof Loads: **<Insert applicable roof loads.>**
    - d. Snow Loads: **<Insert applicable snow loads.>**
    - e. Wind Loads: **<Insert applicable wind loads.>**
    - f. Seismic Loads: **<Insert applicable seismic loads.>**
    - g. **<Insert loads.>**
  2. Deflection Limits: Design framing systems to withstand[ **design loads**] without deflections greater than the following:
    - a. Exterior Load-Bearing Wall Framing: Horizontal deflection of [**1/240**] [**1/360**] [**1/600**] [**1/720**] of the wall height.
    - b. Interior Load-Bearing Wall Framing: Horizontal deflection of [**1/240**] [**1/360**] of the wall height under a horizontal load of **5 lbf/sq. ft. (239 Pa)**.
    - c. Exterior Non-Load-Bearing Framing: Horizontal deflection of [**1/240**] [**1/360**] [**1/600**] [**1/720**] **<Insert ratio>** of the wall height.
    - d. Floor Joist Framing: Vertical deflection of 1/480 for live loads and 1/360 for total loads of the span.
    - e. Roof Trusses: Vertical deflection of [**1/240**] [**1/360**] of the span.

### 1.3 SUBMITTALS

- A. Product Data: For each type of product and accessory indicated.
- B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
  - 1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Welding certificates.
- D. Qualification data.
- E. Product test reports.
- F. Research/evaluation reports.

### 1.4 QUALITY ASSURANCE

- A. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements.
- B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code--Sheet Steel."
- C. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
- D. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
  - 1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
  - 2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."
- E. Comply with AISI's "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
1. Grade: [**ST33H** (**ST230H**)] [**ST50H** (**ST340H**)] [**As required by structural performance**] **<Insert grade>**.
  2. Coating: [**G60** (**Z180**), **A60** (**ZF180**), **AZ50** (**AZ150**), or **GF30** (**ZGF90**)] [**G90** (**Z275**) or equivalent] **<Insert coating weight>**.

## 2.2 LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: [**0.0329 inch** (**0.84 mm**)] [**0.0428 inch** (**1.09 mm**)] [**0.0538 inch** (**1.37 mm**)] [**0.0677 inch** (**1.72 mm**)] [**0.0966 inch** (**2.45 mm**)].
  2. Section Properties: **<Insert minimum allowable calculated section modulus, moment of inertia, and allowable moment.>**
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and same minimum base-metal thickness as steel studs.
- C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, punched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: [**0.0329 inch** (**0.84 mm**)] [**0.0428 inch** (**1.09 mm**)] [**0.0538 inch** (**1.37 mm**)] [**0.0677 inch** (**1.72 mm**)] [**0.0966 inch** (**2.45 mm**)].
  2. Flange Width: [**1-3/8 inches** (**35 mm**)] [**1-5/8 inches** (**41 mm**)] [**2 inches** (**51 mm**)] [**2-1/2 inches** (**63 mm**)].
  3. Section Properties: **<Insert minimum allowable calculated section modulus, moment of inertia, and allowable moment.>**

## 2.3 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: [**0.0329 inch** (**0.84 mm**)] [**0.0428 inch** (**1.09 mm**)] [**0.0538 inch** (**1.37 mm**)] [**0.0677 inch** (**1.72 mm**)] [**0.0966 inch** (**2.45 mm**)].
  2. Flange Width: [**1-3/8 inches** (**35 mm**)] [**1-5/8 inches** (**41 mm**)] [**2 inches** (**51 mm**)] [**2-1/2 inches** (**63 mm**)].
  3. Section Properties: **<Insert minimum allowable calculated section modulus, moment of inertia, and allowable moment.>**
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and same minimum base-metal thickness as steel studs.

- C. Vertical Deflection Clips: Manufacturer's standard **[bypass]** **[head]** clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads.
- E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

## 2.4 FLOOR JOIST FRAMING

- A. Steel Joists: Manufacturer's standard C-shaped steel joists, of web depths indicated, **[unpunched,]** **[punched,]** **[punched, with enlarged service holes,]** with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: **[0.0329 inch (0.84 mm)]** **[0.0428 inch (1.09 mm)]** **[0.0538 inch (1.37 mm)]** **[0.0677 inch (1.72 mm)]** **[0.0966 inch (2.45 mm)]**.
  - 2. Flange Width: **[1-5/8 inches (41 mm)]** **[2 inches (51 mm)]** **[2-1/2 inches (63 mm)]**, minimum.
  - 3. Section Properties: **<Insert minimum allowable calculated section modulus, moment of inertia, and allowable moment.>**
- B. Steel Joist Track: Manufacturer's standard U-shaped steel joist track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: Matching steel joists.
  - 2. Flange Width: **[1-5/8 inches (41 mm)]** **[2 inches (51 mm)]** **[2-1/2 inches (63 mm)]**, minimum.

## 2.5 ROOF TRUSSES

- A. Roof Truss Members: Manufacturer's standard **[-shape steel sections]** **[C-shaped steel sections, of web depths indicated, unpunched, with stiffened flanges]**.

## 2.6 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members, unless otherwise indicated.
- B. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

- C. Anchor Bolts: ASTM F 1554, Grade [36] [55], threaded carbon-steel [hex-headed bolts] [headless, hooked bolts] [headless bolts, with encased end threaded,] and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by [hot-dip process according to ASTM A 153/A 153M, Class C] [mechanically deposition according to ASTM B 695, Class 50].
- D. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
- E. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- F. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
  - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

## 2.7 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: [SSPC-Paint 20 or DOD-P-21035] [ASTM A 780].
- B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Shims: Load bearing, high-density multimonomer plastic, nonleaching.
- D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.
- B. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

### 3.2 INSTALLATION, GENERAL

- A. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.
- B. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
- C. Install framing members in one-piece lengths.
- D. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- E. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
- F. Install insulation, specified in Division 7 Section "Building Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- G. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- H. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of **1/8 inch in 10 feet (1:960)** and as follows:
  - 1. Space individual framing members no more than plus or minus **1/8 inch (3 mm)** from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

### 3.3 LOAD-BEARING WALL INSTALLATION

- A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
  - 1. Anchor Spacing: **[24 inches (610 mm)] [32 inches (813 mm)] [To match stud spacing] [As shown on Shop Drawings].**
- B. Squarely seat studs against top and bottom tracks with gap not exceeding of **1/8 inch (3 mm)** between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:
  - 1. Stud Spacing: **[12 inches (305 mm)] [16 inches (406 mm)] [19.2 inches (488 mm)] [24 inches (610 mm)] [As indicated].**

- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.
- D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
- E. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.
- G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
  - 1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
  - 2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
  - 1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.
- I. Install horizontal bridging in stud system, spaced [**48 inches (1220 mm)**] [**as indicated**] [**as indicated on Shop Drawings**]. Fasten at each stud intersection.
  - 1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of 2 screws into each flange of the clip angle for framing members up to **6 inches (150 mm)** deep.
  - 2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
  - 3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- J. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.
- K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

### 3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to **[ top and ]** bottom track, unless otherwise indicated. Space studs as follows:
  - 1. Stud Spacing: **[ 12 inches (305 mm) ] [ 16 inches (406 mm) ] [ 19.2 inches (488 mm) ] [ 24 inches (610 mm) ] [ As indicated ].**
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
  - 1. Install single deflection tracks and anchor to building structure.
  - 2. Install double deflection tracks and anchor outer track to building structure.
  - 3. Connect vertical deflection clips to **[bypassing] [infill]** studs and anchor to primary building structure.
- E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than **48 inches (1220 mm)** apart. Fasten at each stud intersection.
  - 1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within **[ 12 inches (305 mm) ] [ 18 inches (450 mm) ]** of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
    - a. Install solid blocking at **[ 96-inch (2440-mm) centers ] [ centers indicated ] [ centers indicated on Shop Drawings ].**
  - 2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
  - 3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
  - 4. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable curtain-wall-framing system.

### 3.5 JOIST INSTALLATION

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
  - 1. Install joists over supporting frame with a minimum end bearing of **1-1/2 inches (38 mm)**.
  - 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.
- C. Space joists not more than **2 inches (51 mm)** from abutting walls, and as follows:
  - 1. Joist Spacing: [**12 inches (305 mm)**] [**16 inches (406 mm)**] [**19.2 inches (488 mm)**] [**24 inches (610 mm)**] [**As indicated**].
- D. Frame openings with built-up joist headers consisting of joist and joist track, nesting joists, or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated[ **on Shop Drawings**].
  - 1. Install web stiffeners to transfer axial loads of walls above.
- F. Install bridging at intervals indicated[ **on Shop Drawings**]. Fasten bridging at each joist intersection as follows:
  - 1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
  - 2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.
- G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

### 3.6 TRUSS INSTALLATION

- A. Install, bridge, and brace trusses according to Shop Drawings and requirements in this Section.
- B. Truss Spacing: [**16 inches (406 mm)**] [**19.2 inches (488 mm)**] [**24 inches (610 mm)**] [**32 inches (813 mm)**] [**48 inches (1220 mm)**] [**As indicated**].

- C. Do not alter, cut, or remove framing members or connections of trusses.
- D. Erect trusses with plane of truss webs plumb and parallel to each other, align, and accurately position at spacings indicated.
- E. Erect trusses without damaging framing members or connections.
- F. Align webs of bottom chords and load-bearing studs or continuously reinforce track to transfer loads to structure. Anchor trusses securely at all bearing points.
- G. Install continuous bridging and permanently brace trusses as indicated[ **on Shop Drawings and designed according to LGSEA's Technical Note 551e, "Design Guide for Permanent Bracing of Cold-Formed Steel Trusses."**] [.]

### 3.7 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.8 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05400

## SECTION 06402 - INTERIOR ARCHITECTURAL WOODWORK

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 7. Plastic-laminate countertops.
- B. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips unless concealed within other construction before woodwork installation.

#### 1.2 SUBMITTALS

- C. Samples:
  - 3. Plastic-laminates, for each type, color, pattern, and surface finish.
- E. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

#### 1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of woodwork.
- B. Quality Standard: Unless otherwise indicated, comply with AWTs "Architectural Woodwork Quality Standards."

#### 1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

### PART 2 - PRODUCTS

#### 2.1 WOODWORK FABRICATORS

- A. Fabricators: Subject to compliance with requirements, provide interior architectural woodwork by one of the following:

## 2.2 MATERIALS

- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

## 2.5 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- E. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

## 2.6 FABRICATION

- A. General: Complete fabrication to maximum extent possible before shipment to Project site. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
  - 1. Interior Woodwork Grade: Custom.
  - 2. Shop cut openings to maximum extent possible. Sand edges of cutouts to remove splinters and burrs. Seal edges of openings in countertops with a coat of varnish.
- I. Plastic-Laminate Countertops:
  - 1. High-Pressure Decorative Laminate Grade: HGS.
  - 3. Colors, Patterns, and Finishes: As selected by Architect from laminate manufacturer's full range of solid colors and patterns, matte finish.
  - 4. Edge Treatment: As indicated.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas. Examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.
- B. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- C. Install woodwork level, plumb, true, and straight to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm). Shim as required with concealed shims.

- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- K. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop. Calk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."

END OF SECTION 06402

## SECTION 08110 - STEEL DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and door schedule.
- B. Comply with ANSI/SDI 100.
- C. Fire-Rated Door Assemblies: NFPA 80, tested per ASTM E 152, and labeled and listed by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Cold-Rolled Steel Sheets: ASTM A 366/A 366M or ASTM A 620/A 620M.
- B. Galvanized Steel Sheets: ASTM A 653/A 653M, commercial steel, or ASTM A 642/A 642M, drawing quality, with A60 or G60 (ZF180 or Z180) coating designation, mill phosphatized.

#### 2.2 STEEL DOORS AND FRAMES

- A. Door Silencers: Three on strike jambs of single-door frames and two on heads of double-door frames.
- B. Plaster Guards: Provide where mortar might obstruct hardware operation and to close off interior of openings.
- C. Fabricate steel frames to be rigid, neat in appearance, and free from defects, warp, or buckle.
  - 1. Interior Frames: Fabricate with mitered or coped and continuously welded corners, formed from 0.0478-inch- (1.2-mm-) thick, cold-rolled steel for openings 48 inches (1220 mm) or less in width and from 0.0598-inch- (1.5-mm-) thick steel for openings more than 48 inches (1220 mm) in width.
  - 2. Exterior Frames: Fabricate with mitered or coped and continuously welded corners, formed from 0.0635-inch- (1.6-mm-) thick, galvanized steel sheet.
- D. Prepare doors and frames to receive mortised and concealed hardware according to SDI 107.
- E. Prime Coat: Galvanized steel, FS TT-P-641, Type II zinc-dust, zinc-oxide primer.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Place steel frames to comply with SDI 105.
- B. Prime Coat Repair: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and repair finish with compatible air-drying primer.

END OF SECTION 08110

## SECTION 08211 - FLUSH WOOD DOORS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Solid-core doors with wood-veneer faces.

#### 1.2 SUBMITTALS

A. Product Data: For each type of door indicated. Include factory-finishing specifications.

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.
4. Indicate doors to be factory finished and finish requirements.

D. Samples: For factory-finished doors.

#### 1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

B. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated."

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Algoma Hardwoods, Inc.
2. Ampco, Inc.
3. Buell Door Company Inc.
4. Chappell Door Co.

5. Eagle Plywood & Door Manufacturing, Inc.
6. Eggers Industries.
7. Graham; an Assa Abloy Group company.
8. Haley Brothers, Inc.
9. Ideal Architectural Doors & Plywood.
10. Ipik Door Company.
11. Lambton Doors.
12. Marlite.
13. Marshfield Door Systems, Inc.
14. Mohawk Flush Doors, Inc.; a Masonite company.
15. Oshkosh Architectural Door Company.
16. Poncraft Door Company.
17. Vancouver Door Company.
18. VT Industries Inc.

## 2.2 DOOR CONSTRUCTION, GENERAL

- A. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.
- B. WDMA I.S.1-A Performance Grade:
  1. Heavy Duty unless otherwise indicated.
- C. Particleboard-Core Doors:
- D. Structural-Composite-Lumber-Core Doors:
  1. Structural Composite Lumber: WDMA I.S.10.
    - b. Screw Withdrawal, Edge: 400 lbf (1780 N).

## 2.3 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

- B. Interior Solid-Core Doors:
  1. Grade: Custom (Grade A faces).
  2. Species: Red oak.
  3. Cut: Plain sliced (flat sliced).
  4. Match between Veneer Leaves: Slip match.
  5. Assembly of Veneer Leaves on Door Faces: Running match.
  7. Core: Structural composite lumber.
  8. Construction: Five plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering.
  9. Construction: Seven plies, either bonded or nonbonded construction.

## 2.4 DOORS FOR OPAQUE FINISH

B. Interior Solid-Core Doors:

1. Grade: Custom.
2. Faces: Any closed-grain hardwood of mill option.
3. Core: Structural composite lumber.
4. Construction: Five plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering.

2.6 LOUVERS AND LIGHT FRAMES

A. Metal Louvers:

1. Metal and Finish: Hot-dip galvanized steel, 0.040 inch (1.0 mm) thick, factory primed for paint finish.

2.7 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with requirements in NFPA 80 for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied.

C. Openings: Cut and trim openings through doors in factory.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Division 8 Section "Glazing."

2.9 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Finish doors at factory that are indicated to receive transparent finish. Field finish doors indicated to receive opaque finish.

C. Transparent Finish:

1. Grade: Custom.

2. Finish: AWI conversion varnish or catalyzed polyurethane system.
5. Staining: As selected by Architect from manufacturer's full range.
6. Effect: Filled finish.
7. Sheen: Satin.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Hardware: For installation, see Division 8 Section "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
  1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
  1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.
    - a. Comply with NFPA 80 for fire-rated doors.
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

END OF SECTION 08211

## **SECTION 08410 – ALUMINUM ENTRANCES AND STOREFRONTS**

### **PART 1 GENERAL**

#### **1.1 SUMMARY**

- A. Section includes: Requirements including but not limited to:
  - 3. Storefront type framing system
  - 4. Finish system.
  - 5. Accessories required for a complete assembly.
- B. Related Work:
  - 3. Section 08800 - Glazing

#### **1.2 SYSTEM DESCRIPTION**

- A. Aluminum Entrance and Storefront System: System capable of withstanding loads and thermal and structural movement requirements indicated without failure, based on testing manufacturer's standard units in assemblies similar to those indicated. Failure includes but is not limited to:
  - 1. Air infiltration and water penetration exceeding specified limits.
  - 2. Framing members transferring stresses, including those caused by thermal and structural movement, to glazing units.
- B. Glazing: Physically and thermally isolate glazing from framing members.
- C. Thermally Broken Construction: Systems that isolate aluminum exposed to exterior from aluminum exposed to interior with a material of low thermal conductance.
- D. Wind Loads: System, including anchorage, capable of withstanding wind load design pressures calculated according to requirements of authorities having jurisdiction or the American Society of Civil Engineers' ASCE 7, *Minimum Design Loads for Buildings and Other Structures*, 6.4.2, *Analytical Procedure*, whichever are more stringent.
  - 1. Deflection of framing members in a direction normal to wall plane is limited to 1/175 of clear span or 3/4 inch (19 mm), whichever is smaller, unless otherwise indicated.
  - 2. Static Pressure Test Performance: Provide entrance and storefront systems that do not evidence material failures, structural distress, failure of operating components to function normally, or permanent deformation of main framing members exceeding 0.2 percent of clear span when tested according to ASTM E 330.
    - a. Test Pressure: 150 percent of inward and outward wind load design pressures.

- b. Duration: As required by design wind velocity; fastest 1 mile (1.609 km) of wind for relevant exposure category.
- E. Seismic Loads: System, including anchorage, capable of withstanding the effects of earthquake motions calculated according to requirements of authorities having jurisdiction or ASCE 7, *Minimum Design Loads for Buildings and Other Structures*, Section 9, *Earthquake Loads*, whichever are more stringent.
- F. Dead Loads: System members that do not deflect an amount which will reduce glazing bite below 75 percent of design dimension when carrying full dead load.
  - 1. Provide minimum 1/8 inch (3.18mm) clearance between members and top of glazing or other fixed part immediately below.
- G. Live Loads: System, including anchorage, accommodating supporting structures deflection from uniformly distributed and concentrated live loads indicated without failure of materials or permanent deformation.
- H. Air Infiltration: System with permanent resistance to air leakage through fixed glazing and frame areas of maximum 0.06 cfm/sq. ft. (0.3 L/s/sq. m) of fixed wall area when tested according to ASTM E 283 at static air pressure difference of 1.57 lbf/sq. ft. (75.2 Pa).
- I. Water Penetration: System not evidencing water leakage through fixed glazing and frame areas when tested according to ASTM E 331 at minimum differential pressure of 20 percent of inward acting wind load design pressure as defined by ASCE 7, *Minimum Design Loads for Buildings and Other Structures*, but not less than 6.24 lbf/sq. ft. (299 Pa). Water leakage is defined as follows:
  - 1. Uncontrolled water infiltrating systems or appearing on systems' normally exposed interior surfaces from sources other than condensation. Water controlled by flashing and gutters that is drained back to the exterior and cannot damage adjacent materials or finishes is not water leakage.
- J. Thermal Movements: System, including anchorage, accommodating thermal movements of systems and supporting elements resulting from maximum change (range) of 120 degrees F (67 degrees C in ambient temperatures and 180 degrees F (100 degrees C) surface temperatures without buckling, damaging stresses on glazing, failure of joint sealants, damaging loads on fasteners, failure of doors or other operating units to function properly, and other detrimental effects.
- K. Structural Support Movement: System accommodating structural movements including, but not limited to, sway and deflection.
- L. Condensation Resistance: System with condensation resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.1.
- M. Average Thermal Conductance: System with average U values of not more than 0.63 Btu/sq. ft. x h x degrees F (3.57 W/sq. m x K) when tested according to AAMA 1503.1.

- N. Dimensional Tolerances: System accommodating dimensional tolerances of building frame and other adjacent construction.

### **1.3 QUALITY ASSURANCE**

- A. Regulatory Requirements:

- 1. Applicable requirements for the American Disabilities Act Accessibility Guidelines (ADAAG) for Buildings and Facilities; Final Guidelines, including revisions and updates.
- 2. Perform work in accordance with AAMA SFM-1 and AAMA Metal Curtain Wall, Window, Store Front and Entrance Guide Specifications Manual.
- 3. Comply with requirements of ANSI A117.1.

- B. Installer Qualifications: Installer specializing in aluminum storefront systems having minimum 10 years documented experience and approved by system manufacturer.

- 1. Engineering Responsibility: Prepare data for entrance and storefront systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

- C. Manufacturer's/Fabricator's Qualifications: Systems produced and fabricated by firm having minimum 10 years documented experienced and having sufficient production capacity to produce components required without causing delay in progress of work.

- 1. Engineering Responsibility: Prepare data for entrance and storefront systems, including Shop Drawings, based on testing and engineering analysis of specified units in assemblies similar to those indicated.

- D. Single Source Responsibility: Obtain aluminum entrance and storefront systems and curtain wall system from one source and from a single manufacturer.

- E. Testing Agency Qualifications: Demonstrate to Engineer's satisfaction, based on Engineer's evaluation of criteria conforming to ASTM E 699, that the independent testing agency has experience and capability to satisfactorily conduct the testing indicated without delaying the work.

- F. Preconstruction Sealant Testing: Perform sealant manufacturers' standard tests for compatibility and adhesion of sealants with each material in contact with sealants and each condition required by system.

- 1. Test a minimum of 8 samples of each metal, glazing, and other material.
- 2. Prepare samples using techniques and primers required for installed systems.
- 3. Perform tests under environmental conditions that duplicate those under which systems will be installed.

4. For materials that fail tests, determine corrective measures required to prepare each material to ensure compatibility with and adhesion of sealants, including, but not limited to, specially formulated primers. After performing corrective measures on minimum number of samples required for each material, retest materials.
- G. Welding Standards: Comply with applicable provisions of AWS D1.2, *Structural Welding Code--Aluminum*.

#### 1.4 SUBMITTALS

- A. Product Data: For each product specified. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes.
- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components, provisions for expansion and contraction, and attachments to other work.
  1. For entrance systems, include hardware schedule complying with Section 08710 and indicate operating hardware types, quantities, and locations.
- C. Cutaway Sample: Of each vertical to horizontal framing intersection of systems, made from minimum 6 inch (150mm) lengths of full size components and showing details of the following:
  1. Joinery.
  2. Anchorage.
  3. Expansion provisions.
  4. Glazing.
  5. Flashing and drainage.
- D. Installer Certificates: Signed by manufacturer certifying installers comply with specified requirements.
- E. Sealant Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating materials forming joint substrates and joint sealant backings have been tested for compatibility and adhesion with sealants. Submit joint sealant manufacturers' written interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed to obtain adhesion.
- F. Test Reports:
  1. Field Test: Indicate and interpret test results for compliance with storefront systems' performance requirements.
  2. Product Test: Based on evaluation of tests performed by manufacturer and witnessed by a qualified independent testing agency, indicate compliance of entrance and

storefront systems with requirements based on comprehensive testing of current systems.

## **1.5 PROJECT CONDITIONS**

- A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.
  - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating systems without field measurements. Coordinate construction to ensure actual dimensions correspond to established dimensions.

## **1.6 WARRANTY**

- A. Manufacturer's Warranty: Submit a written warranty executed by the manufacturer agreeing to repair or replace components of entrance and storefront systems that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:
  - 1. Structural failures including, but not limited to, excessive deflection.
  - 2. Adhesive sealant failures.
  - 3. Cohesive sealant failures.
  - 4. Failure of system to meet performance requirements.
  - 5. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 6. Failure of operating components to function normally.
- B. Warranty Period: 2 years from date of Substantial Completion.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Arch Amarlite.
  - 2. Butler Manufacturing Company; Vistawall Architectural Products.
  - 3. CMI Architectural Products, Inc.
  - 4. Commercial Architectural Products, Inc.
  - 5. EFCO Corporation.
  - 6. International Aluminum Corporation; U.S. Aluminum.

7. Kawneer Company, Inc.
8. Pittco Architectural Metals, Inc.
9. Tajima Corporation.
10. Tubelite Architectural Systems.
11. WCI Company; Waltek.

## **2.2 MATERIALS**

- B. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with the requirements of standards indicated below.
1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
  2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221 (ASTM B 221M).
  3. Extruded Structural Pipe and Tubes: ASTM B 429.
  4. Bars, Rods, and Wire: ASTM B 211 (ASTM B 211M).
  5. Welding Rods and Bare Electrodes: AWS A5.10.
- C. Steel Reinforcement: Complying with ASTM A 36 (ASTM A 36M) for structural shapes, plates, and bars; ASTM A 611 for cold rolled sheet and strip; or ASTM A 570 (ASTM A 570M) for hot-rolled sheet and strip.
1. Glazing: Refer to Section 08800.
- D. Glazing Gaskets: Pressure glazing system of black, resilient glazing gaskets, setting blocks, and shims or spacers, fabricated from an elastomer of type and in hardness recommended by system and gasket manufacturer to comply with system performance requirements. Provide gasket assemblies that have corners sealed with sealant recommended by gasket manufacturer.
- E. Spacers, Setting Blocks, Gaskets, and Bond Breakers: Permanent, nonmigrating types in hardness recommended by manufacturer, compatible with sealants, and suitable for system performance requirements.
- F. Secondary Sealant: For use as weatherseal, compatible with structural silicone sealant and other system components with which it comes in contact, and that accommodates a 50 percent increase or decrease in joint width at the time of application when measured according to ASTM C 719.
1. Color: Clear Anodized Aluminum.
  2. Use neutral cure silicone sealant with insulating glass units.
- G. Framing system gaskets, sealants, and joint fillers as recommended by manufacturer for joint type.

- I. Bituminous Paint: Cold applied asphalt mastic paint complying with SSPC-Paint 12 requirements, containing no asbestos, formulated for 30 mil (0.762mm) thickness per coat.

## **2.3 COMPONENTS**

- A. Storefront Framing System: Thermally broken with interior tubular section insulated from exterior framing system including subframes and reinforcing members; flush glazing from exterior on all sides without projecting stops; drainage holes; internal weep drainage system. Frames for interior glazing need not to be thermally broken. Shop fabricate and preassemble frame components where possible. Provide storefront frame sections without exposed seams.
  1. Mullion Configurations: Provide pockets at inside glazing face to receive resilient elastomeric glazing; one piece mullions and horizontals. Make provisions to drain moisture accumulation to exterior.
  2. Reinforced Mullion: Profile of extruded aluminum with internal reinforcement of shaped steel structural section.
- B. Brackets and Reinforcements: Provide brackets and reinforcements compatible with adjacent materials. Provide nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Corrosion resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
  1. Reinforce members as required to retain fastener threads.
  2. Do not use exposed fasteners, except for hardware application. For hardware application, use countersunk Phillips flat head machine screws finished to match framing members or hardware being fastened, unless otherwise indicated.
- D. Concrete and Masonry Inserts: Hot dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123 or ASTM A 153 requirements.
- E. Concealed Flashing: Corrosion resistant, nonstaining, nonbleeding flashing, compatible with adjacent materials, and of type recommended by manufacturer.
- F. Weather Stripping: Manufacturer's standard replaceable weather stripping as follows:
  1. Compression Weather Stripping: Molded neoprene complying with ASTM D 2000 requirements or molded PVC complying with ASTM D 2287 requirements.
  2. Sliding Weather Stripping: Wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum strip backing complying with AAMA 701 requirements.
- G. Hardware: Refer to Section 08710.

## **2.4 FABRICATION**

- A. Prefabrication: Complete fabrication, assembly, finishing, hardware application, and work to greatest extent possible before shipment to site. Disassemble components as necessary for shipment and installation.
  - 1. Perform fabrication operations, including cutting, fitting, forming, drilling and grinding of metal work to prevent damage to exposed finish surfaces. Complete operations for hardware prior to application of finishes.
  - 2. Do not drill and tap for surface mounted hardware items until time of installation at site.
  - 3. Coordinate fabrication with steel doors to be inserted in frames.
- B. Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.
  - 1. Fabricate components for screw spline frame construction.
  - 2. Thermal Break Construction: Fabricate system with integrally concealed, low conductance thermal barrier, located between exterior materials and exposed interior members to eliminate direct metal to metal contact.
- C. Forming: Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.
  - 1. Prepare components to receive concealed fasteners and anchor and connection devices.
  - 2. Fabricate components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior.
- D. Welding: Weld components to comply with referenced AWS standard. Weld before finishing components to greatest extent possible. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- E. Glazing Channels: Provide minimum clearances for thickness and type of glass indicated according to FGMA's *Glazing Manual*.
- F. Reinforcing: Install reinforcing required for hardware and for performance requirements, sag resistance, and rigidity.
- G. Dissimilar Metals: Separate dissimilar metals with bituminous paint, suitable sealant, nonabsorptive plastic or elastomeric tape, or gasket between surfaces. Do not use coatings containing lead.
- H. Continuity: Maintain accurate relation of planes and angles with hairline fit of contacting members.

1. Uniformity of Metal Finish: Abutting extruded aluminum members may shall have integral color or texture variation no greater than half range indicated in sample pair submittal.
- I. Fasteners: Conceal fasteners wherever possible.
- J. Finger Guards: Provide finger guards of collapsible neoprene or PVC gasketing securely anchored into frame at hinge jamb of center pivoted doors.
- K. Entrances: Coordinate fabrication with steel doors. Reinforce as required to support imposed loads. Factory frame units and factory install hardware to greatest extent possible. Reinforce door and frame units as required for installing hardware indicated. Cut, drill, and tap for factory installed hardware before finishing components.
1. Exterior Doors: Provide compression weather stripping at fixed stops. At other locations, provide sliding weather stripping retained in adjustable strip mortised into door edge.
2. Interior Doors: Provide ANSI/BHMA A156.16 silencers at stops to prevent metal to metal contact. Provide 3 silencers on strike jamb of single door frames and 2 silencers on head of double door frames.

## **2.5 FINISHES**

- A. Comply with NAAMM's *Metal Finishes Manual for Architectural and Metal Products* for recommendations relative to applying and designating finishes.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within 1/2 of range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas for compliance with requirements for installation tolerances and other conditions affecting performance of entrance and storefront systems. Do not proceed with installation until unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Comply with manufacturer's written instructions for protecting, handling, and installing entrance systems. Do not install damaged components. Fit frame joints to produce

hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.

- B. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints and condensation and moisture occurring or migrating within system to exterior.
- D. Set continuous sill members and flashing in full sealant bed to provide weathertight construction. Comply with requirements of Section 07900.
- E. Install framing components plumb and true in alignment with established lines and grades without warp or rack of framing members.
- F. Install entrances plumb and true in alignment with established lines and grades without warp or rack. Lubricate operating hardware and other moving parts according to hardware manufacturers' written instructions.
  - 1. Install surface mounted hardware according to manufacturer's written instructions using concealed fasteners to greatest extent possible.
- G. Install glazing to comply with requirements of Section 08800.
  - 1. Prepare surfaces in contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
  - 2. Install structural silicone sealant according to sealant manufacturer's written instructions.
  - 3. Mechanically fasten glazing in place until structural sealant is cured.
  - 4. Remove excess sealant from component surfaces before sealant has cured.
- H. Install secondary sealant weatherseal according to sealant manufacturer's written instructions to provide weatherproof joints. Install joint fillers behind sealant as recommended by sealant manufacturer.
- I. Install perimeter sealant to comply with requirements of Section 07900.
- J. Erection Tolerances: Install entrance and storefront systems to comply with the following maximum tolerances:
  - 1. Variation from Plane: Limit variation from plane or location shown to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.

2. Alignment: Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm). Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).
3. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

### **3.3 FIELD QUALITY CONTROL**

- A. Water Spray Test: After completing the installation of test areas indicated, test storefront system for water penetration according to AAMA 501.2 requirements.
- B. Repair or remove and replace work not meeting requirements or damaged by testing; replace to conform to specified requirements.

### **3.4 ADJUSTING AND CLEANING**

- A. Adjust doors and hardware to provide tight fit at contact points and weather stripping, smooth operation, and weathertight closure.
- B. Remove excess sealant and glazing compounds, and dirt from surfaces.

### **3.5 PROTECTION**

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure entrance systems are without damage or deterioration at the time of Substantial Completion.

**\*\*END OF SECTION\*\***



## SECTION 08520 - ALUMINUM WINDOWS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes operable aluminum-framed windows.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. General: Provide aluminum windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified, and that are of minimum test size required by AAMA/WDMA 101/I.S.2/NAFS.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of aluminum window indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, and installation details
- C. Samples: For each exposed finish.
- D. Product Schedule: Use same designations indicated on Drawings.
- E. Field quality-control test reports.
- F. Product test reports.
- G. Maintenance data.

#### 1.4 QUALITY ASSURANCE

- A. Installer: A qualified installer, approved by manufacturer to install manufacturer's products.
- B. Glazing Publications: Comply with published recommendations of glass manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

#### 1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Failure to meet performance requirements.
    - b. Structural failures including excessive deflection, water leakage, air infiltration, or condensation.
    - c. Faulty operation of movable sash and hardware.
    - d. Deterioration of metals, other materials, and metal finishes beyond normal weathering.
    - e. Failure of insulating glass.
  - 2. Warranty Period:
    - a. Window: Three years from date of Substantial Completion.
    - b. Glazing: 10 years from date of Substantial Completion.
    - c. Metal Finish: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. All Seasons Windows & Doors; All Seasons Commercial Division, Inc.
  - 2. Arcadia, Inc.
  - 3. Boyd Aluminum Manufacturing.
  - 4. Champion Aluminum Window Corp.
  - 5. Columbia Commercial Building Products.
  - 6. Columbia Windows & Doors.
  - 7. Crystal Window & Door Systems, Ltd.
  - 8. Custom Window Company.
  - 9. DeSCo Windows.
  - 10. EFCO Corporation.
  - 11. EXTECH Exterior Technologies, Inc.
  - 12. Fleetwood Aluminum Products, Inc.
  - 13. Gerkin Windows and Doors.
  - 14. Graham Architectural Products Corp.
  - 15. Heritage Window and Door, Inc.
  - 16. Kawneer; an Alcoa Company.
  - 17. Mannix; a division of Interstate Window Corp.
  - 18. Mercer Industries, Inc.
  - 19. MI Windows and Doors, Inc.

20. Moduline Window Systems.
21. Peerless Products Inc.
22. Pioneer Window Manufacturing Corp.
23. Rebco, Inc.
24. Seasonshield, Inc.
25. Thermal Windows, Inc.
26. TRACO.
27. U.S. Aluminum.
28. Wausau Window and Wall Systems.
29. Winco Window Company.
30. Window Technologies, Inc.; Century Manufacturing, Inc.
31. Wojan Window & Door Corporation.
32. YKK AP America Inc.

## 2.2 WINDOW

- A. Window Type: As indicated on Drawings.
  - B. Comply with AAMA/WDMA 101/I.S.2/NAFS.
3. Performance Class and Grade: C30.

## 2.3 GLAZING

- A. Glass and Glazing Materials: Refer to Division 8 Section "Glazing" for glass units and glazing requirements applicable to glazed aluminum window units.
- B. Glass: Clear tempered single pane glazing complying with Division 8 Section "Glazing."

## 2.5 FABRICATION

- A. Fabricate aluminum windows that are reglazable without dismantling sash or ventilator framing.
- E. Mullions: Provide mullions and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units.
- F. Subframes: Provide subframes with anchors for window units as shown, of profile and dimensions indicated but not less than 0.062-inch- (1.6-mm-) thick extruded aluminum. Miter or cope corners, and weld and dress smooth with concealed mechanical joint fasteners. Finish to match window units. Provide subframes capable of withstanding design loads of window units.

- G. Glazing Stops: Provide snap-on glazing stops coordinated with Division 8 Section "Glazing" and glazing system indicated. Provide glazing stops to match sash and ventilator frames.

## 2.6 ALUMINUM FINISHES

- A. Aluminum Anodic Finish: Class II, clear anodic coating complying with AAMA 611.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
- C. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.
- D. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.
- F. Adjust operating sashes and ventilators, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.
- G. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- H. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.
- I. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 08520

## SECTION 08710 - DOOR HARDWARE

### PART 1 - GENERAL

#### 1.1 SECTION REQUIREMENTS

- A. Allowances: Provide hardware under Hardware Allowance in Division 1 Section "Price and Payment Procedures."
- B. Submittals: Hardware Schedule.
- C. Deliver keys to Owner.
- D. For fire-rated openings provide hardware tested and listed by UL or FM (NFPA 80). On exit devices provide UL or FM label indicating "Fire Exit Hardware."

### PART 2 - PRODUCTS

#### 2.1 HARDWARE

- A. Hinges: Provide the following:
  - 1. Dark bronze hinges with stainless-steel pins for exterior.
  - 2. Nonremovable hinge pins for exterior and public interior exposure.
  - 3. Ball-bearing hinges for doors with closers and entry doors.
  - 4. Three hinges for 1-3/4-inch thick doors 90 inches or less in height; four hinges for doors more than 90 inches in height.
- B. Locksets and latchsets as follows:
  - 1. BHMA A156.2, Series 4000, Grade [1] [2] [3] for bored locks and latches.
  - 2. BHMA A156.3, Grade 1 for exit devices.
  - 3. Lever handles on locksets and latchsets, Sargent LJ Design or similar, Dark Bronze
  - 4. Provide trim on exit devices matching locksets.
- C. Key locks to Owner's new master-key system.
  - 1. Cylinders with five-pin tumblers.
  - 2. Provide construction keying.
  - 3. Provide key control system, including cabinet.
- D. Closers: Provide the following:
  - 1. Mount closers on interior side (room side) of door opening. Provide regular-arm, parallel-arm, or top-jamb-mounted closers as necessary.
  - 2. Adjustable delayed opening (accessible to the disabled) feature on closers.

- E. Provide wall stops or floor stops for doors without closers.
- F. Provide hardware finishes as follows:
  - 1. Hinges: Matching finish of lockset/latchset].
  - 2. Locksets, Latchsets, and Exit Devices: Dark Bronze or Oil-rubbed, oxidized bronze]
  - 3. Closers [Matching finish of lockset/latchset].
  - 4. Other Hardware: Matching finish of lockset/latchset.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Mount hardware in locations recommended by the Door and Hardware Institute, unless otherwise indicated.

#### 3.2 HARDWARE SCHEDULE

- A. To follow.

END OF SECTION 08710

## SECTION 09111 - NON-LOAD-BEARING STEEL FRAMING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes non-load-bearing steel framing members for the following applications:

1. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

### PART 2 - PRODUCTS

#### 2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
  2. Protective Coating: ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized, unless otherwise indicated.

#### 2.3 STEEL FRAMING FOR FRAMED ASSEMBLIES

- A. Steel Studs and Runners: ASTM C 645.
1. Minimum Base-Metal Thickness: 0.027 inch (0.7 mm).
  2. Depth: 3-5/8 inches (92.1 mm).

#### 2.4 AUXILIARY MATERIALS

- A. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.

2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.
  1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
  2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
  3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
  4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

### 3.3 INSTALLING FRAMED ASSEMBLIES

- A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- B. Install studs so flanges within framing system point in same direction.
  1. Space studs as follows:
    - a. Single-Layer Application: 24 inches (610 mm) o.c., unless otherwise indicated.
- C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
  2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two studs at each jamb, unless otherwise indicated.
    - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (12.7-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
    - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
  3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

END OF SECTION 09111

## SECTION 09250 - GYPSUM DRYWALL

### PART 1 - GENERAL

#### 1..1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1..2 SUMMARY:

- A. Extent of each type of gypsum drywall construction required is indicated on Drawings.
- B. This Section includes the following types of gypsum board construction:
  - 1. Gypsum board screw-attached to wood, metal framing and furring members.
- C. Wood framing and furring are specified in the following Division 6 sections:
  - 1. "Rough Carpentry."

#### 1..3 DEFINITIONS:

- A. Gypsum Board Construction Terminology: Refer to ASTM C 11 and GA 505 for definitions of terms for gypsum board construction not otherwise defined in this section or other referenced standards.

#### 1..4 SUBMITTALS:

- A. Product data from manufacturers for each type of product specified.

#### 1..5 QUALITY ASSURANCE:

- A. Fire-Resistance Ratings: Where indicated, provide materials and construction which are identical to those of assemblies whose fire resistance rating has been determined per ASTM E 119 by a testing and inspecting organization acceptable to authorities having jurisdiction.
  - 1. Provide fire-resistance-rated assemblies identical to those indicated by reference to GA File No's. in GA-600 "Fire Resistance Design Manual" or to design designations in U.L. "Fire Resistance Directory" or in listing of other testing and agencies acceptable to authorities having jurisdiction.
- B. Single Source Responsibility: Obtain each type of gypsum board and related joint treatment materials from a single manufacturer.

#### 1..6 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct

sunlight, surface contamination, corrosion, construction traffic and other causes. Neatly stack gypsum boards flat to prevent sagging.

- C. Handle gypsum boards to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal corner beads and trim.

#### 1..7 PROJECT CONDITIONS:

- A. Environmental Conditions, General: Establish and maintain environmental conditions for application and finishing gypsum board to comply with ASTM C 840 and with gypsum board manufacturer's recommendations.
- B. Minimum Room Temperatures: For nonadhesive attachment of gypsum board to framing, maintain not less than 40 deg F (4 deg C). For adhesive attachment and finishing of gypsum board maintain not less than 50 deg F (10 deg C) for 48 hours prior to application and continuously thereafter until drying is complete.
- C. Ventilate building spaces to remove water not required for drying joint treatment materials. Avoid drafts during dry, hot weather to prevent materials from drying too rapidly.

### PART 2 - PRODUCTS

#### 2..1 MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
  - 1. Gypsum Boards and Related Products:
    - a. Norwest Gypsum Co.
    - b. Georgia-Pacific Corp.
    - c. Gold Bond Building Products Div., National Gypsum Co.
    - d. United States Gypsum Co.
  - 2. Steel Framing and Furring:
    - a. Clark Steel Framing, Inc.
    - b. Consolidated Systems, Inc.
    - c. Dale Industries, Inc.
    - d. Dietrich Industries, Inc.
    - e. Marino/Ware (formerly Marino Industries Corp.).
    - f. National Gypsum Co.; Gold Bond Building Products Division.
    - g. Unimast, Inc.
- B. Steel Rigid Furring Channels: ASTM C 645, hat-shaped, depth of 7/8 inch, and minimum thickness of base (uncoated) metal as follows:
  - 1. Thickness: 0.0179 inch, unless otherwise indicated.
- C. Grid Suspension System: ASTM C 645, manufacturer's standard grid suspension system composed of main beams and cross furring members which interlock to form a modular supporting network.

2..2 GYPSUM BOARD:

- A. General: Provide gypsum board of types indicated in maximum lengths available to minimize end-to-end joints.
  - 1. Thickness: Provide gypsum board in thicknesses indicated, or if not otherwise indicated, in either 1/2 inch or 5/8 inch thicknesses to comply with ASTM C 840 for application system and support spacing indicated.
- B. Gypsum Wallboard: ASTM C 36, and as follows:
  - 1. Type: Regular, unless otherwise indicated.
  - 2. Type: Type X for fire-resistance-rated assemblies.
  - 3. Edges: Tapered.
  - 4. Thickness: 5/8" unless otherwise indicated.
  - 5. Available Products: Subject to compliance with requirements, products which may be incorporated in the Work where Type X gypsum wallboard is indicated include, but are not limited to, the following:
  - 6. Products: Subject to compliance with requirements, provide one of the following products where Type X gypsum wallboard is indicated:
    - a. "Gyprock Fireguard 'C' Gypsum Board"; Domtar Gypsum Co.
    - b. "Fire-Shield G"; Gold Bond Building Products Div., National Gypsum Co.
    - c. "SHEETROCK Brand FIRECODE 'C' Gypsum Panels"; United States Gypsum Co.
- C. Water-Resistant Gypsum Backing Board: ASTM C 630, and as follows:
  - 1. Type: Type X for fire-resistance-rated assemblies.
  - 2. Thickness: 5/8 inch, unless otherwise indicated.

2..3 TRIM ACCESSORIES:

- A. Cornerbead and Edge Trim for Interior Installation: Provide corner beads, edge trim and control joints which comply with ASTM C 1047 and requirements indicated below:
  - 1. Material: Formed metal, plastic or metal combined with paper, with metal complying with the following requirement:
    - a. Sheet steel zinc-coated by hot-dip process.
  - 2. Edge trim shapes indicated below by reference to designations of Fig. 1 in ASTM C 1047:
    - a. "LC" Bead, unless otherwise indicated.
    - b. "LK" Bead with square nose for use with kerfed jambs.
    - c. "L" Bead where indicated.
    - d. "U" Bead where indicated.
  - 3. One-Piece Control Joint: Formed with vee-shaped slot per Fig. 1 in ASTM C 1047, with slot opening covered with removable strip.

2..4 GYPSUM BOARD JOINT TREATMENT MATERIALS:

- A. General: Provide materials complying with ASTM C 475, ASTM C 840, and recommendations of manufacturer of both gypsum board and joint treatment materials for the application indicated.
- B. Joint Tape: Paper reinforcing tape, unless otherwise indicated.

1. Use pressure sensitive or staple-attached open-weave glass fiber reinforcing tape with compatible joint compound where recommended by manufacturer of gypsum board and joint treatment materials for application indicated.
- C. Drying-Type Joint Compounds: Factory-prepackaged vinyl-based products complying with the following requirements for formulation and intended use.
  1. Ready-Mix Formulation: Factory-premixed product.
  2. Taping compound formulated for embedding tape and for first coat over fasteners and flanges of corner beads and edge trim.
  3. Topping compound formulated for fill (second) and finish (third) coats.
  4. All-purpose compound formulated for use as both taping and topping compound.

## 2..5 MISCELLANEOUS MATERIALS:

- A. General: Provide auxiliary materials for gypsum drywall construction which comply with referenced standards and the recommendations of the manufacturer of the gypsum board.
- B. Spot Grout: ASTM C 475, setting-type joint compound of type recommended for spot grouting hollow metal door frames.
- C. Fastening Adhesive for Wood: ASTM C 557.
- D. Gypsum Board Screws: ASTM C 1002.
- E. Sound Attenuation Blankets: Unfaced mineral fiber blanket insulation produced by combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665 for Type I (blankets without membrane facing); and as follows:
  1. Mineral Fiber Type: Fibers manufactured from glass. Include at all walls surrounding Offices, Break Room and Toilet Rooms.

## 2..6 STEEL FRAMING FOR WALLS AND PARTITIONS

- B. General: Provide steel framing members complying with the following requirements:
  1. Protective Coating: Manufacturer's standard corrosion-resistant coating.
- C. Steel Studs and Runners: ASTM C 645, with flange edges of studs bent back 90 degrees and doubled over to form **3/16-inch- (5-mm-)** wide minimum lip (return), and complying with the following requirements for minimum thickness of base (uncoated) metal and for depth:
  1. Thickness: 20 Gg. as follows:
    - a. For head runner, sill runner, jamb, and cripple studs at door and other openings.
    - b. In locations to receive cementitious backer units.
  2. Thickness: As indicated.
  3. Depth: As indicated.
- D. Steel Rigid Furring Channels: ASTM C 645, hat shaped, depth and minimum thickness of base (uncoated) metal as follows:
  1. Thickness: **0.0329 inch (0.84 mm)**, unless otherwise indicated.
  2. Depth: **7/8 inch (22.2 mm)**.

- E. Furring Brackets: Serrated-arm type, adjustable, fabricated from corrosion-resistant steel sheet complying with ASTM C 645, minimum thickness of base (uncoated) metal of 0.0329 inch (0.84 mm), designed for screw attachment to steel studs and steel rigid furring channels used for furring.
- F. Fasteners for Metal Framing: Provide fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel framing and furring members securely to substrates involved; complying with the recommendations of gypsum board manufacturers for applications indicated.

### PART 3 - EXECUTION

#### 3..1 EXAMINATION:

- A. Examine substrates to which drywall construction attaches or abuts, preset hollow metal frames, cast-in-anchors, and structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of drywall construction. Do not proceed with installation until unsatisfactory conditions have been corrected.

#### 3..2 PREPARATION:

- A. Ceiling Anchorages: Coordinate installation of ceiling suspension system with installation of overhead structural systems to ensure that inserts and other structural anchorage provisions have been installed to receive ceiling anchors in a manner that will develop their full strength and at spacing required to support ceiling.

#### 3..3 APPLICATION AND FINISHING OF GYPSUM BOARD, GENERAL:

- A. Gypsum Board Application and Finishing Standard: Install and finish gypsum board to comply with ASTM C 840.
- B. Install sound attenuation blankets where indicated, prior to gypsum board unless readily installed after board has been installed.
- C. Locate exposed end-butt joints as far from center of walls and ceilings as possible, and stagger not less than 24 inches in alternate courses of board.
- D. Install ceiling boards across framing in the manner which minimizes the number of end-butt joints, and which avoids end joints in the central area of each ceiling. Stagger end joints at least 24 inches.
- E. Install wall/partition boards in manner which minimizes the number of end-butt joints or avoids them entirely where possible. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs.
- F. Install exposed gypsum board with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for a light contact at edges and ends with not more than 1/16 inch open space between boards. Do not force into place.
- G. Locate either edge or end joints over supports, except in horizontal applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Position boards so that like edges abut, tapered edges against tapered edges and mill-cut or field-cut ends against mill-cut or field-cut ends. Do not place tapered edges against cut edges or ends. Stagger vertical joints over different studs on opposite sides of partitions.

- H. Attach gypsum board to supplementary framing and blocking provided for additional support at openings and cutouts.
- I. Spot grout hollow metal door frames for solid core wood doors, hollow metal doors and doors over 32 inches wide. Apply spot grout at each jamb anchor clip just before inserting board into frame.
- J. Form control joints and expansion joints at locations indicated, with space between edges of boards, prepared to receive trim accessories.
- K. Isolate perimeter of non-load-bearing drywall partitions at structural abutments. Provide 1/4 inch to 1/2 inch space and trim edge with "U" bead edge trim. Seal joints with acoustical sealant.
- K. Floating Construction: Where feasible, including where recommended by manufacturer, install gypsum board over wood framing, with "floating" internal corner construction.
- L. Where sound-rated drywall construction is indicated, seal construction at perimeters, control and expansion joints, openings and penetrations with a continuous bead of acoustical sealant including a bead at both faces of partitions. Comply with ASTM C 919 and manufacturer's recommendations for location of edge trim, and close off sound-flanking paths around or through construction, including sealing of partitions above acoustical ceilings.
- M. Space fasteners in gypsum boards in accordance with referenced gypsum board application and finishing standard and manufacturer's recommendations.

### 3..4 INSTALLATION OF STEEL FRAMING FOR WALLS AND PARTITIONS:

- A. Install runners (tracks) at floors, ceilings and structural walls and columns where gypsum drywall stud system abuts other construction.
  - 1. Where studs are installed directly against exterior walls, install asphalt felt strips between studs and wall.
- B. Installation Tolerances: Install each steel framing and furring member so that fastening surface do not vary more than 1/8 inch from plane of faces of adjacent framing.
- C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
- D. Terminate partition framing at suspended ceilings where indicated.
- E. Install steel studs and furring in sizes and at spacings indicated but not less than that required by referenced steel framing installation standard.
- F. Install steel studs so that flanges point in the same direction and gypsum boards can be installed in the direction opposite to that of the flange.
- G. Frame door openings to comply with details indicated, with GA-219 and with applicable published recommendations of gypsum board manufacturer. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
  - 1. Extend vertical jamb studs through suspended ceilings and attach to underside of floor or roof structure above.

- H. Frame openings other than door openings to comply with details indicated, or if none indicated, in same manner as required for door openings; and install framing below sills of openings to match framing required above door heads.
- I. Install thermal insulation as follows:
  - 1. Erect insulation vertically and hold in place with Z-furring members spaced 24 inches on center.
  - 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches on center.
  - 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw attach short flange of furring channel to web of attached channel. Start from this furring channel with standard width insulation panel and continue in regular manner. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.
  - 4. Until gypsum board is installed hold insulation in place with 10 inch staples fabricated from 0.0625 inch (16 gage) diameter tie wire and inserted through slot in web of member.
- J. Install polyethylene vapor retarder on interior of framing members of exterior insulated walls to comply with the following requirements:
  - 1. Extend vapor retarder to extremities of exterior insulated walls and to cover miscellaneous voids in insulated substrates, including those which have been stuffed with loose thermal insulation.
  - 2. Seal vertical joints in vapor retarders over framing by lapping not less than 2 wall studs. Fasten vapor retarders to framing at top, end, and bottom edges, at perimeter of wall openings, and at lap joints; space fasteners 16 inches on center.
  - 3. Seal joints in vapor retarder caused by pipes, conduits, electrical boxes and similar items penetrating vapor retarders with cloth or aluminized tape which bonds permanently to vapor retarder.
  - 4. Repair any tears or punctures in vapor retarder immediately before concealment by application of gypsum board or other construction.

### 3..5 METHODS OF GYPSUM BOARD APPLICATION:

- A. Single-Layer Application: Install gypsum wallboard as follows:
  - 1. On ceilings apply gypsum board prior to wall/partition board application to the greatest extent possible.
  - 2. On partitions/walls apply gypsum board vertically (parallel to framing), unless otherwise indicated, and provide sheet lengths which will minimize end joints.
  - 3. On partitions/walls 8'-1" or less in height apply gypsum board horizontally (perpendicular to framing); use maximum length sheets possible to minimize end joints.
- B. Wall Tile Base: Where drywall is base for thin-set ceramic tile and similar rigid applied wall finishes, install gypsum backing board.
  - 1. At "wet" areas, install water- resistant gypsum backing board to comply with ASTM C 840 and recommendations of gypsum board manufacturer.
- C. Single-Layer Fastening Methods: Apply gypsum boards to supports as follows:
  - 1. Fasten with screws.
  - 2. Fasten to wood supports with adhesive and supplementary nails or screws.

### 3..6 INSTALLATION OF DRYWALL TRIM ACCESSORIES:

- A. General: Where feasible, use the same fasteners to anchor trim accessory flanges as required to fasten gypsum board to the supports. Otherwise, fasten flanges to comply with manufacturer's recommendations.
- B. Install corner beads at external corners.
- C. Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi-exposed, and except where plastic trim is indicated. Provide type with face flange to receive joint compound except where "U" bead (semi-finishing type) is indicated.
  - 1. Install "LC" bead where drywall construction is tightly abutted to other construction and back flange can be attached to framing or supporting substrate.
  - 2. Install "LK" bead where substrate is kerfed to receive long flange of trim.
  - 3. Install "L" bead where edge trim can only be installed after gypsum board is installed.
  - 4. Install U-type trim where edge is exposed, revealed, gasketed, or sealant-filled (including expansion joints).
- D. Install U-bead where indicated, and where exterior gypsum board edges are not covered by applied moldings or indicated to receive edge trim with face flanges covered with joint compound.
- E. Install control joints at locations indicated, or if not indicated, at spacings and locations required by referenced gypsum board application and finish standard, and approved by the Architect for visual effect.

### 3..7 FINISHING OF DRYWALL:

- A. General: Apply joint treatment at gypsum board joints (both directions); flanges of corner bead, edge trim, and control joints; penetrations; fastener heads, surface defects and elsewhere as required to prepare work for decoration.
- B. Prefill open joints and rounded or beveled edges, if any, using setting-type joint compound.
- C. Apply joint tape at joints between gypsum boards, except where trim accessories are indicated.
- D. Finish interior gypsum wallboard by applying the following joint compounds in 3 coats (not including prefill of openings in base), and sand between coats and after last coat:
  - 1. Embedding and First Coat: Job-mixed drying-type taping compound.
  - 2. Fill (Second) Coat: Job-mixed drying-type topping compound.
  - 3. Finish (Third) Coat: Job-mixed drying-type topping compound.
- E. Water-Resistant Gypsum Backing Board Base for Ceramic Tile: Comply with ASTM C 840 and manufacturer's recommendations for treatment of joints behind tile.
- F. Partial Finishing: Omit third coat and sanding on concealed drywall construction which is indicated for drywall finishing or which requires finishing to achieve fire-resistance rating, sound rating or to act as air or smoke barrier.

### 3..8 APPLICATION OF TEXTURE FINISH (Ceiling of Lobby Area only):

- A. Surface Preparation and Primer: Prepare and prime drywall and other surfaces in strict accordance with texture finish manufacturer's instructions. Apply primer to all surfaces to achieve texture finish.
- B. Finish Application: Mix and apply finish to drywall and other surfaces indicated to receive finish in strict accordance with manufacturer's instructions to produce a uniform texture matching Architect's sample without

starved spots or other evidence of thin application, and free of application patterns.

3..9 PROTECTION:

- A. Provide final protection and maintain conditions, in a manner suitable to Installer, which ensures gypsum drywall construction being without damage or deterioration at time of Substantial Completion.

END OF SECTION 09250

## SECTION 09510- ACOUSTIC CEILINGS

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

A. Section includes: Requirements including but not limited to:

1. Acoustical panels.
2. Exposed suspension systems for ceilings.

#### **1.2 DEFINITIONS**

- A. AC: Articulation Class.
- B. CAC: Ceiling Attenuation Class.
- C. LR: Light Reflectance coefficient.
- D. NRC: Noise Reduction Coefficient.

#### **1.3 QUALITY ASSURANCE**

- A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.
- B. Source Limitations:
1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
  2. Suspension System: Obtain each type through one source from a single manufacturer.
  3. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
    - a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
    - b. Identify materials with appropriate markings of applicable testing and inspecting agency.

4. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
  - a. Smoke-Developed Index: 450 or less.
- C. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following for Seismic Design Category: E.
  1. UBC Standard 25-2, "Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings."

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Coordinate Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
  1. Ceiling suspension members.
  2. Method of attaching hangers to building structure.
  3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- C. Samples for Initial Selection: For components with factory-applied color finishes.
- D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
  1. Acoustical Panel: Set of 6 inch (150-mm) square Samples of each type, color, pattern, and texture.
  2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- (300-mm-) long Samples of each type, finish, and color.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.
- F. Research/Evaluation Reports: For each acoustical panel ceiling and components.
- G. Maintenance Data: For finishes to include in maintenance manuals.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where

they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

## **1.6 PROJECT CONDITIONS**

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

## **1.7 COORDINATION**

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

## **1.8 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
  - 2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide one of the products specified.
  - 1. Armstrong.
  - 2. USG Interiors, Inc.
- B. Basis-of-Design Product: The design for each tile type is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product to one of the manufacturers specified.

## **2.2 ACOUSTICAL PANELS, GENERAL**

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
  - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.
- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

## **2.3 WATER-FELTED, MINERAL-BASE ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING, ACT-1:**

- A. Basis of Design Product:
  - 1. United States Gypsum Millenium "F" Fissured, medium texture, pattern No. 76907, white, or approval equal.
- B. Classification: Provide panels complying with ASTM E 1264 for Type III, mineral base with painted finish; Form 2, water felted; and pattern CE.
- C. NRC: Not less than 0.70.
- D. CAC: Not less than 35.
- E. LR: Not less than .79
- F. Edge Detail: Square.
- G. Thickness: 3/4 inch (19 mm).
- H. Size: 24 by 24 inches (610 by 610 mm)

## **2.4 METAL SUSPENSION SYSTEMS, GENERAL**

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
- C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
  2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.
- D. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- E. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.

## **2.5 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILINGS ACT-1.**

- A. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/653M, not less than G30 (Z90) coating designation, with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges.
1. Structural Classification: Heavy-duty system.
  2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
  3. Face Design: Flat, flush.
  4. Cap Material: Steel or aluminum cold-rolled sheet.
  5. Cap Finish: Painted white.

## **2.6 METAL EDGE MOLDINGS AND TRIM**

- A. Roll-Formed Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

# **PART 3 - EXECUTION**

## **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

### **3.3 INSTALLATION, GENERAL**

- A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
  - 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
  - 5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
  - 6. Do not attach hangers to steel deck tabs.
  - 7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  - 8. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for

hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
  - 1. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.66 m). Miter corners accurately and connect securely.
  - 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
  - 1. Arrange directionally patterned acoustical panels as follows:
    - a. As indicated on reflected ceiling plans.
  - 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.

### **3.4 CLEANING**

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

**\*\*END OF SECTION\*\***

## SECTION 09653 - RESILIENT WALL BASE AND ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and color Samples.
- B. Extra Materials: Deliver to Owner at least 10 linear feet for each 500 linear feet or fraction thereof, of each type and color of resilient wall base installed.

### PART 2 - PRODUCTS

#### 2.1 WALL BASE

- A. Roppe, or equal
  - 1. Color and Pattern: As selected.
- B. Type: Rubber, FS SS-W-40, Type I.
- C. Style: Straight with no toe at carpet
- D. Minimum Thickness: 0.085 inch.
- E. Height: 4 inches
- F. Lengths: Coils in lengths standard with manufacturer, but not less than 96 feet.
- G. Outside Corners: Premolded.
- H. Inside Corners: Premolded.
- I. Surface: Smooth.

#### 2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement- or blended hydraulic cement-based formulation provided or approved by resilient product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Adhesively install resilient wall base and accessories.
- B. Install wall base in maximum lengths possible. Apply to walls, columns, pilasters, casework, and other permanent fixtures in rooms or areas where base is required.
  - 1. Job-Formed Corners: Form wall base corners from straight pieces of maximum lengths possible.
- C. Install reducer strips at edges of flooring that otherwise would be exposed.

END OF SECTION 09653

## SECTION 09680 - SHEET CARPETING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes tufted carpet.

#### 1.2 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Shop Drawings: Show the following:
  - 1. Seam locations.
  - 2. Pattern type, repeat size, location, direction, and starting point.
  - 3. Pile direction.
  - 4. Edge, transition, and other accessory strips.
  - 5. Transition details to other flooring materials.
- C. Samples: For each color and texture required.
  - 1. Carpet: 12-inch- (300-mm-) square Sample.
  - 2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch- (300-mm-) long Samples.
- D. Maintenance data.

#### 1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104, Section 5, "Storage and Handling."

#### 1.5 PROJECT CONDITIONS

- A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."

1.6 WARRANTY

- A. Special Warranty for Carpet: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delamination.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Carpet: Full-width rolls equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

PART 2 - PRODUCTS

2.1 WOVEN CARPET

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
- B. Products: Subject to compliance with requirements, provide one of the following:
  - 1. Design Weave, Harmonics.
    - a. Color: As selected by Architect from manufacturer's full range.
    - b. Pattern: As Selected by Architect from manufacturer's full range.
    - c. Source: Shaw Contract.
- C. Fiber Content: 100 percent nylon.
- D. Pile Characteristic: Loop pile graphic.
- E. Tufted Yarn Weight: 28 oz.
- F. Density: 9,164
- G. Finished Pile Thickness: .11 inch for finished carpet.
- H. Backing:
  - 1. Backcoating: polypropylene
  - 2. Secondary Backing: ActionBac.
- I. Applied Soil-Resistance Treatment: Designweave SP.

- J. Performance Characteristics: As follows:
1. Dry Breaking Strength: Not less than 100 lbf (445 N) per ASTM D 2646.
  2. Resistance to Insects: Comply with AATCC 24.
  3. Noise Reduction Coefficient (NRC): per ASTM C 423.
  4. Colorfastness to Crocking: Not less than 4, wet and dry, per AATCC 165.
  5. Colorfastness to Light: Not less than 4 after 60 AFU (AATCC fading units) per AATCC 16, Option E.
  6. Electrostatic Propensity: Less than 2 kV per AATCC 134.
  7. VOC Limits: Provide carpet that complies with the following limits for VOC content when tested according to ASTM D 5116:
    - a. Total VOCs: 0.5 mg/sq. m x h.
    - b. 4-PC (4-Phenylcyclohexene): 0.05 mg/sq. m x h.
    - c. Formaldehyde: 0.05 mg/sq. m x h.
    - d. Styrene: 0.4 mg/sq. m x h.

## 2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet manufacturer.
1. VOC Limits: Provide adhesives that comply with the following limits for VOC content when tested according to ASTM D 5116:
    - a. Total VOCs: 10.00 mg/sq. m x h.
    - b. Formaldehyde: 0.05 mg/sq. m x h.
    - c. 2-Ethyl-1-Hexanol: 3.00 mg/sq. m x h.
- C. Tackless Carpet Stripping: Water-resistant plywood, in strips as required to match cushion thickness and that comply with CRI 104, Section 12.2.
- D. Seam Adhesive: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with CRI 104 and carpet manufacturer's written installation instructions for the following:
1. Direct-Glue-Down Installation: Comply with CRI 104, Section 9, "Direct Glue-Down Installation."

- B. Comply with carpet manufacturer's written recommendations and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
- C. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- D. Install pattern parallel to walls and borders.

END OF SECTION 09680

## SECTION 09912 - INTERIOR PAINTING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following interior substrates:
  - 1. Gypsum board.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each finish and for each color and texture required.
- C. Product List: Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

#### 1.3 QUALITY ASSURANCE

- A. MPI Standards:
  - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
  - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

#### 1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
  - 1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

### PART 2 - PRODUCTS

#### 2.1 PAINT, GENERAL

- A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Chemical Components of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions; these requirements do not apply to primers or finishes that are applied in a fabrication or finishing shop:
1. Flat Paints and Coatings: VOC content of not more than 50 g/L.
  2. Nonflat Paints and Coatings: VOC content of not more than 150 g/L.
  3. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
  4. Restricted Components: Paints and coatings shall not contain any of the following:
    - a. Acrolein.
    - b. Acrylonitrile.
    - c. Antimony.
    - d. Benzene.
    - e. Butyl benzyl phthalate.
    - f. Cadmium.
    - g. Di (2-ethylhexyl) phthalate.
    - h. Di-n-butyl phthalate.
    - i. Di-n-octyl phthalate.
    - j. 1,2-dichlorobenzene.
    - k. Diethyl phthalate.
    - l. Dimethyl phthalate.
    - m. Ethylbenzene.
    - n. Formaldehyde.
    - o. Hexavalent chromium.
    - p. Isophorone.
    - q. Lead.
    - r. Mercury.
    - s. Methyl ethyl ketone.
    - t. Methyl isobutyl ketone.
    - u. Methylene chloride.
    - v. Naphthalene.
    - w. Toluene (methylbenzene).
    - x. 1,1,1-trichloroethane.
    - y. Vinyl chloride.
- C. Colors: As selected by Architect from manufacturer's full range.

## 2.2 LATEX PAINTS

- A. Interior Latex (Semigloss): MPI #54 (Gloss Level 5).
  - 1. VOC Content: E Range of E2.
  - 2. Environmental Performance Rating: EPR 2.
- B. Interior Latex (Gloss): MPI #114 (Gloss Level 6, except minimum gloss of 65 units at 60 deg).
  - 1. VOC Content: E Range of E2.
  - 2. Environmental Performance Rating: EPR 2.
- C. Institutional Low-Odor/VOC Latex (Semigloss): MPI #147 (Gloss Level 5).
  - 1. VOC Content: E Range of E3.
  - 2. Environmental Performance Rating: EPR 3.

## 2.3 QUICK-DRYING ENAMELS

- A. Quick-Drying Enamel (Semigloss): MPI #81 (Gloss Level 5).
  - 1. VOC Content: E Range of E2.
- B. Quick-Drying Enamel (High Gloss): MPI #96 (Gloss Level 7).
  - 1. VOC Content: E Range of E2.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Masonry (Clay and CMU): 12 percent.
  - 2. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
  - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

### 3.2 PREPARATION AND APPLICATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
  - 1. Mechanical Work:
    - a. Uninsulated metal piping.
    - b. Uninsulated plastic piping.
    - c. Pipe hangers and supports.
    - d. Tanks that do not have factory-applied final finishes.
    - e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
    - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
  - 2. Electrical Work:
    - a. Switchgear.
    - b. Panelboards.
    - c. Electrical equipment that is indicated to have a factory-primed finish for field painting.
- E. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- F. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.3 INTERIOR PAINTING SCHEDULE

- 1. Latex Over Sealer System: MPI INT 3.1A.
  - a. Prime Coat: Interior latex primer/sealer.

- b. Intermediate Coat: Interior latex matching topcoat.
    - c. Topcoat: Interior latex (semigloss).
  - 2. Institutional Low-Odor/VOC Latex System: MPI INT 3.1M.
    - a. Prime Coat: Institutional low-odor/VOC interior latex matching topcoat.
    - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
    - c. Topcoat: Institutional low-odor/VOC interior latex (semigloss).
- B. Gypsum Board Substrates:
- 1. Latex System: MPI INT 9.2A.
    - a. Prime Coat: Interior latex primer/sealer.
    - b. Intermediate Coat: Interior latex matching topcoat.
    - c. Topcoat: Interior latex (semigloss).
  - 2. Institutional Low-Odor/VOC Latex System: MPI INT 9.2M.
    - a. Prime Coat: Interior latex primer/sealer.
    - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
    - c. Topcoat: Institutional low-odor/VOC interior latex (semigloss).

END OF SECTION 09912

## SECTION 12491 - HORIZONTAL LOUVER BLINDS

### PART 1 - GENERAL

#### 1.1 SECTION REQUIREMENTS

- A. Submittals: Product Data and color Samples.
- B. Provide blinds passing NFPA 701.
- C. Provide electrical components that comply with NFPA 70 and that are listed and labeled by UL.
- D. Extra Materials: Deliver to Owner full-size blind units equal to 5 percent of amount installed, packaged with protective covering for storage.

### PART 2 - PRODUCTS

#### 2.1 HORIZONTAL LOUVER BLINDS

- 1. Color: TBD.
- B. Louver Material: Aluminum.
- C. Louver Width: 1 inch (25 mm) (miniblinds).
- D. Tilt Operation: Manual with cord.
- E. Headrail Mounting: Horizontal surface between window jambs.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install blinds level, plumb, and located not closer than 1 inch (25 mm) to interior face of glass lites.
- B. Isolate metal parts from concrete or mortar to prevent galvanic action. Use tape or another method recommended by manufacturer.

END OF SECTION 12491

**DIVISION 15 - MECHANICAL**

|       |                                   |
|-------|-----------------------------------|
| 15010 | GENERAL REQUIREMENTS              |
| 15050 | BASIC MATERIALS & METHODS         |
| 15075 | MECHANICAL IDENTIFICATION         |
| 15083 | HVAC INSULATION                   |
| 15815 | METAL DUCTS                       |
| 15820 | DUCT ACCESSORIES                  |
| 15840 | AIR TERMINAL UNITS                |
| 15855 | DIFFUSERS, REGISTERS, AND GRILLES |
| 15900 | HVAC INSTRUMENTATION AND CONTROLS |
| 15950 | TESTING, ADJUSTING AND BALANCING  |

## **SECTION 15010 - GENERAL REQUIREMENTS**

### **PART 1 - GENERAL**

#### **1.1 GENERAL**

- A. General Conditions and Division 01 apply to this Division.

#### **1.2 SCOPE**

- A. Includes -

1. Furnish all labor, materials, and equipment necessary for the completion of the mechanical and plumbing scope of work.
2. Furnish and install all motors specified in this Division and be responsible for the proper operation of electrical powered equipment furnished by this Division.
3. Furnish exact location of electrical connections and information on motor controls to Division 16.
4. Mechanical Contractor shall obtain the services of independent Test and Balance Agency.
5. Placing the air conditioning, heating, ventilating, and exhaust systems into full operation and continuing their operation during each working day of testing and balancing.
6. Making changes in pulleys, belts, and dampers, or adding dampers, as required for the correct balance as recommended by Balancing Contractor at no additional cost to Owner.
7. Air balance, final adjustment and test run.
8. The satisfactory performance of the completed systems is a requirement of this specification.

- B. Related Work Specified Elsewhere -

1. Conduit, line voltage wiring, outlets, and disconnect switches specified in Division 16.
2. Magnetic starters and thermal protective devices (heaters) not a factory mounted integral part of packaged equipment are specified in Division 16.

#### **1.3 SITE INSPECTION**

- A. The Contractor shall examine the site and understand the conditions which may affect the performance of work of this Division before submitting proposals for this work.
- B. No subsequent allowance for time or money will be considered for any consequence related to failure to examine existing site conditions.

#### **1.4 DRAWINGS**

- A. Mechanical drawings show general arrangement of piping, ductwork, equipment, etc; however, locations are to be regarded as shown diagrammatically only. Follow as closely as actual building construction and work of other trades will permit.
- B. Because of the small scale of mechanical drawings, it is not possible to indicate all offsets, fittings, and accessories which may be required. Investigate existing structural and finished conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.
- C. If changes in location of piping, equipment, ducts, etc. are required due to lack of coordination of work under this division, such changes shall be made without charge. Contractor shall review drawings with local and state agencies having jurisdiction and any changes required by them shall be brought to the attention of the Architect prior to bidding or commencement of work.

#### **1.5 CODE REQUIREMENTS, FEES, AND PERMITS**

- A. The work shall be installed in accordance with the following applicable codes, ordinances and standards unless otherwise specified. The codes and standards shall include but not be limited to and be of the latest and current editions.
  - 1. American Boiler and Affiliated Industries (AB and AI)
  - 2. American Gas Association (AGA)
  - 3. Air Movement and Control Association (AMCA)
  - 4. American National Standards Institute (ANSI)
  - 5. Air Conditioning & Refrigeration Institute (ARI)
  - 6. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) - ASHRAE 90.1-2004
  - 7. American Society of Mechanical Engineers (ASME)
  - 8. American Society of Testing Materials (ASTM)
  - 9. American Standards Association (ASA)
  - 10. American Water Works Association (AWWA)
  - 11. American Welding Society (AWS)
  - 12. Associated Air Balance Council (AABC)
  - 13. Heat Exchange Institute (HEI)
  - 14. Hydraulic Institute (HI)
  - 15. BR
  - 16. National Electrical Code (NEC)
  - 17. National Fire Protection Association (NFPA)
  - 18. Sheet Metal and Air Conditioning contractors National Association (SMACNA)
  - 19. Underwriters Laboratories (UL)
  - 20. International Building Code (IBC) 2006 Ed
  - 21. International Mechanical Code (IMC) 2006 Ed
  - 22. International Plumbing Code (IPC) with Utah Amendments 2006 Ed

23. International Energy Conservation Code (IECC) 2006 Ed
  24. Utah State Safety Orders (OSHA/UOSH)
  25. Utah Fire Rating Bureau
  26. Utah Boiler and Pressure Vessel Law
  27. Utah Air Conservation Regulations/Waste Disposal regulations.
  28. ASHRAE Ventilation STD.62-2004
- B. Should drawings conflict with any code, the code shall govern. If drawings and specifications establish a quality exceeding the code, the drawings and specifications shall govern. If conflicts do exist among the drawings, specifications and codes, the same shall be brought to the attention of the Architect in writing prior to bidding, otherwise Contractor shall comply with applicable codes.
- C. The latest edition of all codes shall be used.
- D. Contractor shall give all notices, obtain all necessary permits, file necessary plans, prepare documents and obtain approvals, and pay all fees required for completion of the mechanical and plumbing work outlined in this Division of the specifications and shown on the Mechanical Drawings.

## 1.6 OPERATION AND MAINTENANCE MANUAL FOR MECHANICAL SYSTEMS

- A. Upon completion of work and before final payment, Contractor shall furnish and deliver to the Owner, through the Architect, installation, operation and maintenance manuals with instructions for all new materials and equipment used in the building. The contractor shall provide three (3) hard copies of the manuals, and three (3) CD's with electronic copies of the manuals. Electronic information shall be .PDF format. The CD's shall include the same information as the hard copies, and shall be organized in the same manner with electronic bookmarks for each section. CD case and the CD itself shall be labeled the same as the hard copies of the manuals.
- B. Bind Operation and Maintenance Manual for Mechanical Systems in a hard-backed piano hinge loose-leaf binder with strong sturdy cover. The project name shall be on the spine and the front of the binder. The front of the binder shall include the following information:

OPERATION  
AND  
MAINTENANCE  
MANUAL  
for MECHANICAL SYSTEMS of  
(Name of Project)  
(Location of Project)  
(Date of Project Award)  
(Name of Architect)

C. Introduction

1. Title page including name of project, project number, date awarded and date of substantial completion.
2. Second page shall contain the names, phone numbers and addresses of Architect, Consulting Engineers, Mechanical Contractor, and General Contractor.
3. Third page shall include a Table of Contents for the entire manual.

D. First Section - Summary information including:

1. First page shall contain the contractor's warranties.
2. Second page shall contain a list of names, addresses and phone numbers of contractors and all sub-contractors and work to which each was assigned.
3. Final page or pages shall contain an equipment list. The list shall contain each item of equipment or material for which a submittal was required giving ID or tag no as contained on the drawings make and model No. Serial No. Identification No. Location in building, function along with the name, address, and phone number of the supplier.

E. Second Section - Mechanical Equipment O&M data including:

1. Mechanical maintenance schedule, including a lubrication list when necessary.
2. Mechanical Equipment Operation and Maintenance Data including:
  - a. Equipment descriptions
  - b. Detailed installation instruction, operating and maintenance instructions. Instructions include in a step by step manner identifying start-up, operating, shutdown and emergency action sequence sufficiently clear so a person unfamiliar with the equipment could perform its operations.
  - c. Equipment drawings, performance curves, operating characteristics, etc.
  - d. Name addresses and phone number of manufacturer, fabricator and local vender clearly printed or stamped on cover.
  - e. Complete parts listing which include catalog number, serial number, contract number or other accurate provision for ordering replacement and spare parts.
  - f. Certified drawings, where applicable, showing assembly of parts and general dimensions.
3. Approved Mechanical submittals

F. Third Section - Plumbing Equipment O&M data including:

1. Section shall contain general product catalog cuts, as well as exploded view drawings with parts lists for all valves and other items with multiple parts.

2. Approved Plumbing submittals
- G. Fourth Section - Controls O&M data including:
1. Sequence of Operation
  2. Description of each operating system included location of switches, breakers, thermostats, and control devices. Provide a single line diagram, showing set points, normal operating parameters for all loads, pressures, temperatures and flow check points; Describe all alarms and cautions for operation.
  3. Provide schematic control diagrams, panel diagrams, wiring diagrams, etc. for each separate fan system, chilled water system, hot water system, exhaust air system, pumps, etc. Each control diagram shall show a schematic representation of mechanical equipment and location of start-stop switches, insertion thermostats, thermometers, pressure gauges, automatic valves, etc. The correct reading for each control instrument shall be marked on the diagram.
- H. The Fifth Section shall contain a complete air and water test and balance report. The report shall contain the name, address and phone number of the agency. It shall also include:
1. Floor plans showing all air openings and thermometer locations clearly marked and cross referenced with data sheets. Format may be 8 1/2 x 11 or 11x14 if legible.
  2. Data sheets showing amount of air and water at each setting. See sections 15950.
  3. List of equipment with date of last calibration.
- I. Drawings and reproducible masters of drawings as required in individual specification sections, are not to be bound in volumes but are to be delivered separate with the maintenance manuals.
- J. See the following checklist for assistance in assembling manual:

| Item #    | Description  | Y, N, or NA |
|-----------|--|-------------|
| 1.        | 3 ring heavy duty binder with Project name, number and date on cover and project name on spine.  |             |
| 2.        | O&M manual on CD (with label on CD matching label on manual). Electronic copy shall be a PDF file with bookmarks that match the tabs in the hard copy. |             |
| 3.        | Title Page [including project name, number, address, date awarded, date of substantial completion]   |             |
| 4.        | Second Page Contact List [including architect (if applicable), mechanical engineer, mechanical contractor, and general contractor (if applicable)]     |             |
| 5.        | Table of Contents  |             |
| <b>6.</b> | <b>Section 1 - Summary</b>   |             |
| A.        | Warranty   |             |
| B.        | Mechanical's Sub-contractor List   |             |
| C.        | Vendor List  |             |

|            |  |  |
|------------|--|--|
| D.         | Equipment List   |  |
| <b>7.</b>  | <b>Section 2 – Mechanical Equipment</b>  |  |
| A.         | Maintenance Schedule (including lubrication list)  |  |
| B.         | Mechanical Equipment O&M Data (for each piece of equipment submitted) per specifications |  |
| C.         | Approved mechanical submittals   |  |
| <b>8.</b>  | <b>Section 3 – Plumbing Equipment</b>  |  |
| A.         | Plumbing equipment O&M data  |  |
| B.         | Approved plumbing submittals   |  |
| <b>9.</b>  | <b>Section 4 - Controls</b>  |  |
| A.         | Sequence of Operation  |  |
| B.         | Controls diagrams  |  |
| C.         | Controls Equipment   |  |
| <b>10.</b> | <b>Section 5 – Test and Balance Report</b>   |  |
| A.         | Complete Test and Balance Report per specifications                                      |  |

## 1.7 OPERATION AND MAINTENANCE INSTRUCTIONS

- A. Contractor shall instruct building maintenance personnel in the operation and maintenance of the installed mechanical systems utilizing the Operation and Maintenance Manual when so doing.
- B. Minimum instruction periods shall be as follows -
  - 1. Mechanical - Two hours.
  - 2. Temperature Control - Two hours.
- C. Instruction periods shall occur before final inspection when systems are properly working and before final payment is made.
- D. None of these instructional periods shall overlap each other.
- E. An additional four hours of instruction will be provided by each contractor, after 60 days of system operation by owner to insure proper system operation and answer questions.

## 1.8 RECORD DRAWINGS

- A. Contractor shall keep an up-to-date set of mechanical and plumbing drawings in his custody showing all changes in red, clearly defined and neatly drafted by him. At the end of construction, he shall turn these drawings over to the Architect. Record drawings must be completed and submitted prior to final inspection.

**PART 2 - PRODUCTS**

(Not Used)

**PART 3 - EXECUTION**

(Not Used)

END OF SECTION 15010

## **SECTION 15050 - BASIC MECHANICAL MATERIALS AND METHODS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Transition fittings.
  - 3. Dielectric fittings.
  - 4. Mechanical sleeve seals.
  - 5. Sleeves.
  - 6. Escutcheons.
  - 7. Grout.
  - 8. Mechanical demolition.
  - 9. Equipment installation requirements common to equipment sections.
  - 10. Painting and finishing.
  - 11. Concrete bases.
  - 12. Supports and anchorages.

#### **1.3 DEFINITIONS**

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PVC: Polyvinyl chloride plastic.

#### **1.4 SUBMITTALS**

- A. Product Data: For the following:
  1. Dielectric fittings.
  2. Mechanical sleeve seals.
- B. Welding certificates.

#### **1.5 QUALITY ASSURANCE**

- A. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

#### **1.7 COORDINATION**

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

### **2.2 PIPE, TUBE, AND FITTINGS**

- A. Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

### **2.3 JOINING MATERIALS**

- A. Refer to individual Division 15 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

## **2.4 DIELECTRIC FITTINGS**

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
  - 1. Available Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Eclipse, Inc.
    - d. Epco Sales, Inc.
    - e. Hart Industries, International, Inc.
    - f. Watts Industries, Inc.; Water Products Div.
    - g. Zurn Industries, Inc.; Wilkins Div.
    - h. Prior Approved Equal.

## **2.5 SLEEVES**

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- E. PVC Pipe: ASTM D 1785, Schedule 40.

## **2.6 ESCUTCHEONS**

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

## **2.7 GROUT**

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## **PART 3 - EXECUTION**

### **3.1 MECHANICAL DEMOLITION**

- A. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated to be removed.
  - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
  - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
  - 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
  - 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  - 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
  - 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

### **3.2 PIPING SYSTEMS - COMMON REQUIREMENTS**

- A. Install piping according to the following requirements and Division 15 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Drawings do not show every offset, or bend that may be required. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors where indicated on drawings and where penetrating will be visible to public.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
  - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for

1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### **3.3 PIPING JOINT CONSTRUCTION**

- A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### **3.4 PIPING CONNECTIONS**

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
  - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### **3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS**

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### **3.6 GROUTING**

- A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 15050

## **SECTION 15075 - MECHANICAL IDENTIFICATION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following mechanical identification materials and their installation:
  - 1. Equipment nameplates.
  - 2. Equipment signs.
  - 3. Access panel and door markers.
  - 4. Pipe markers.
  - 5. Duct markers.
  - 6. Warning tags.

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

#### **1.4 QUALITY ASSURANCE**

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

#### **1.5 COORDINATION**

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with location of access panels and doors.

- C. Install identifying devices before installing acoustical ceilings and similar concealment.

## **PART 2 - PRODUCTS**

### **2.1 EQUIPMENT IDENTIFICATION DEVICES**

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
  - 1. Data:
    - a. Manufacturer, product name, model number, and serial number.
    - b. Capacity, operating and power characteristics, and essential data.
    - c. Labels of tested compliances.
  - 2. Location: Accessible and visible.
  - 3. Fasteners: As required to mount on equipment.
- B. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
  - 1. Data: Instructions for operation of equipment and for safety procedures.
  - 2. Engraving: Manufacturer's standard letter style, 1/4" or larger with terms to match equipment identification.
  - 3. Thickness: 1/8 inch, unless otherwise indicated.
  - 4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
- C. Access Panel and Door Markers: 1/16" thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8" center hole for attachment.
  - 1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

### **2.2 PIPING IDENTIFICATION DEVICES**

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
  - 1. Colors: Comply with ASME A13.1, unless otherwise indicated.
  - 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
  - 3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.

4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
  5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

## **2.3 DUCT IDENTIFICATION DEVICES**

- A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

## **PART 3 - EXECUTION**

### **3.1 APPLICATIONS, GENERAL**

- A. Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

### **3.2 EQUIPMENT IDENTIFICATION**

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
1. Fuel-burning units, including boilers, furnaces, heaters, etc.
  2. Pumps, compressors, chillers, condensers, and similar motor-driven units.
  3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
  4. Fans, blowers, primary balancing dampers, and mixing boxes.
  5. Packaged HVAC central-station and zone-type units.
- B. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
1. Identify mechanical equipment with black equipment markers with white lettering.
  2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
  4. Include signs for the following general categories of equipment:
    - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
    - b. Fuel-burning units, including boilers, furnaces, heaters, etc.
    - c. Pumps, compressors, chillers, condensers, and similar motor-driven units.
    - d. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
    - e. Fans, blowers, primary balancing dampers, and mixing boxes.
    - f. Packaged HVAC central-station and zone-type units.
    - g. Tanks and pressure vessels.
    - h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- C. Install access panel markers with screws on equipment access panels.

### **3.3 PIPING IDENTIFICATION**

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:
  1. Near each valve and control device.
  2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  3. Near penetrations through walls, floors, ceilings, and nonaccessible enclosures.
  4. At access doors, manholes, and similar access points that permit view of concealed piping.
  5. Near major equipment items and other points of origination and termination.
  6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

### **3.4 DUCT IDENTIFICATION**

- A. Install duct markers with permanent adhesive on air ducts in the following color codes:
  1. Green: For cold-air supply ducts.
  2. Yellow: For hot-air supply ducts.
  3. Blue: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
  4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

5. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- B. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

### **3.5 ADJUSTING**

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

### **3.6 CLEANING**

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 15075

## **SECTION 15083 - HVAC INSULATION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Insulation Materials:
    - a. Calcium silicate.
    - b. Mineral fiber.
  - 2. Insulating cements.
  - 3. Adhesives.
  - 4. Factory-applied jackets.
  - 5. Field-applied jackets.
  - 6. Tapes.
  - 7. Securements.
  - 8. Corner angles.
- B. Related Sections:
  - 1. Division 15 Section "Metal Ducts" for duct liners.

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Qualification Data: For qualified Installer.
- C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- D. Field quality-control reports.

#### **1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

#### **1.6 COORDINATION**

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 15 Section "Hangers and Supports."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

#### **1.7 SCHEDULING**

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## **PART 2 - PRODUCTS**

### **2.1 INSULATION MATERIALS**

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Calcium Silicate:
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Industrial Insulation Group (The); Thermo-12 Gold.
    - b. Prior approved equal.
  - 2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
  - 3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
  - 4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Duct Wrap.
    - d. Manson Insulation Inc.; Alley Wrap.
    - e. Owens Corning; All-Service Duct Wrap.
    - f. Prior approved equal.
- H. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Fibrex Insulations Inc.; Coreplus 1200.
  - b. Johns Manville; Micro-Lok.
  - c. Knauf Insulation; 1000 Pipe Insulation.
  - d. Manson Insulation Inc.; Alley-K.
  - e. Owens Corning; Fiberglas Pipe Insulation.
  - f. Prior approved equal.
2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A.

## **2.2 INSULATING CEMENTS**

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Insulco, Division of MFS, Inc.; Triple I.
    - b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.
    - c. Prior approved equal.

## **2.3 ADHESIVES**

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Products, Division of ITW; CP-97.
    - b. Foster Products Corporation, H. B. Fuller Company; 81-27/81-93.
    - c. Marathon Industries, Inc.; 290.
    - d. Mon-Eco Industries, Inc.; 22-30.
    - e. Vimasco Corporation; 760.
    - f. Prior approved equal.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Products, Division of ITW; CP-82.
    - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    - c. ITW TACC, Division of Illinois Tool Works; S-90/80.

- d. Marathon Industries, Inc.; 225.
- e. Mon-Eco Industries, Inc.; 22-25.
- f. Prior approved equal.

D. PVC Jacket Adhesive: Compatible with PVC jacket.

- 1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Dow Chemical Company (The); 739, Dow Silicone.
  - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
  - c. P.I.C. Plastics, Inc.; Welding Adhesive.
  - d. Red Devil, Inc.; Celulon Ultra Clear.
  - e. Speedline Corporation; Speedline Vinyl Adhesive.
  - f. Prior approved equal.

## 2.4 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
  - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

## 2.5 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Johns Manville; Zeston.
    - b. P.I.C. Plastics, Inc.; FG Series.
    - c. Proto PVC Corporation; LoSmoke.
    - d. Speedline Corporation; SmokeSafe.
    - e. Prior approved equal.
  - 2. Adhesive: As recommended by jacket material manufacturer.
  - 3. Color: Color-code jackets based on system. Color as selected by Architect.
  - 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

- a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
5. Factory-fabricated tank heads and tank side panels.

## **2.6 TAPES**

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
    - b. Compac Corp.; 104 and 105.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
    - e. Prior approved equal.
  2. Width: 3 inches.
  3. Thickness: 11.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    - b. Compac Corp.; 110 and 111.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
    - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
    - e. Prior approved equal.
  2. Width: 3 inches.
  3. Thickness: 6.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
  1. Products: Subject to compliance with requirements, provide one of the following:

- a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
    - b. Compac Corp.; 130.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
    - d. Venture Tape; 1506 CW NS.
    - e. Prior approved equal.
  2. Width: 2 inches.
  3. Thickness: 6 mils.
  4. Adhesion: 64 ounces force/inch in width.
  5. Elongation: 500 percent.
  6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - b. Compac Corp.; 120.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
    - d. Venture Tape; 3520 CW.
    - e. Prior approved equal.
  2. Width: 2 inches.
  3. Thickness: 3.7 mils.
  4. Adhesion: 100 ounces force/inch in width.
  5. Elongation: 5 percent.
  6. Tensile Strength: 34 lbf/inch in width.

## **2.7 SECUREMENTS**

- A. Bands:
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Products; Bands.
    - b. PABCO Metals Corporation; Bands.
    - c. RPR Products, Inc.; Bands.
    - d. Prior approved equal.
  2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide.
  3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide.
  4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

## **2.8 CORNER ANGLES**

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.
- C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
  - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
  - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
  - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
  - 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### **3.3 GENERAL INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.
  4. Manholes.
  5. Handholes.
  6. Cleanouts.

### **3.4 PENETRATIONS**

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
  - 1. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
  - 1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
  - 2. Pipe: Install insulation continuously through floor penetrations.
  - 3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."

### **3.5 GENERAL PIPE INSULATION INSTALLATION**

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
  - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
  - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints,

- seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
  6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange

- cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### **3.6 CALCIUM SILICATE INSULATION INSTALLATION**

#### **A. Insulation Installation on Straight Pipes and Tubes:**

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

#### **B. Insulation Installation on Pipe Flanges:**

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
4. Finish flange insulation same as pipe insulation.

#### **C. Insulation Installation on Pipe Fittings and Elbows:**

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
3. Finish fittings insulation same as pipe insulation.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Install insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation same as pipe insulation.

### 3.7 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

4. Install insulation to flanges as specified for flange insulation application.
- E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Impale insulation over pins and attach speed washers.
    - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
  5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
  6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### **3.8 FIELD-APPLIED JACKET INSTALLATION**

- A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
  1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

### **3.9 FIELD QUALITY CONTROL**

- A. Tests and Inspections:
  1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
  2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
  3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### **3.10 DUCT INSULATION SCHEDULE, GENERAL**

- A. Plenums and Ducts Requiring Insulation:
  1. Indoor, concealed supply and outdoor air.
  2. Indoor, exposed supply and outdoor air.
  3. Indoor, concealed return, Air.
  4. Indoor, exposed return, Air.
  5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
  6. Indoor, concealed exhaust.

7. Indoor, exposed exhaust.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

### **3.11 INDOOR DUCT AND PLENUM INSULATION SCHEDULE**

A. Concealed, round and flat-oval duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

B. Concealed, round rectangular, and flat-oval exhaust-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.

C. Rectangular, supply-air duct insulation shall be lined per Section "Metal Ducts".

D. Rectangular, return-air duct insulation shall be lined per Section "Metal Ducts".

E. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.

F. Exposed, round and flat-oval, supply-air, and return air duct insulation shall be a perforated linear. See Section "Metal Ducts".

### **3.12 PIPING INSULATION SCHEDULE, GENERAL**

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### 3.13 INDOOR PIPING INSULATION SCHEDULE

- A. Minimum Pipe Insulation Thickness from ANSI/ASHRAE/IESNA Standard 90.1-2004

| Fluid Design<br>Operating Temp.<br>Range (°F)                   | Insulation Conductivity                         |                            | Nominal |             |             |         |     |
|---|---|----------------------------|---------|-------------|-------------|---------|-----|
|   | Conductivity<br>Btu•in./(h•ft <sup>2</sup> •°F) | Mean<br>Rating<br>Temp. °F | <1      | 1 to <1-1/2 | 1-1/2 to <4 | 4 to <8 | ≥8  |
| <b>Heating Systems (Steam, Steam Condensate, and Hot Water)</b> |   |                            |         |             |             |         |     |
| >350  | 0.32-0.34                                       | 250                        | 2.5     | 3.0         | 3.0         | 4.0     | 4.0 |
| 251-350   | 0.29-0.32                                       | 200                        | 1.5     | 2.5         | 3.0         | 3.0     | 3.0 |
| 201-250   | 0.27-0.30                                       | 150                        | 1.5     | 1.5         | 2.0         | 2.0     | 2.0 |
| 141-200   | 0.25-0.29                                       | 125                        | 1.0     | 1.0         | 1.0         | 1.5     | 1.5 |
| 105-140   | 0.22-0.28                                       | 100                        | 0.5     | 0.5         | 1.0         | 1.0     | 1.0 |
| <b>Domestic and Service Hot Water Systems</b>                   |   |                            |         |             |             |         |     |
| 105+  | 0.22-0.28                                       | 100                        | 0.5     | 0.5         | 1.0         | 1.0     | 1.0 |
| <b>Cooling Systems (Chilled Water, Brine, and Refrigerant)</b>  |   |                            |         |             |             |         |     |
| 40-60   | 0.22-0.28                                       | 100                        | 0.5     | 0.5         | 1.0         | 1.0     | 1.0 |
| <40   | 0.22-0.28                                       | 100                        | 0.5     | 1.0         | 1.0         | 1.0     | 1.5 |

### 3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Exposed:
1. PVC: 20 mils thick.

END OF SECTION 15083

## **SECTION 15815 - METAL DUCTS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval ducts and fittings.
3. Double-wall round and flat-oval ducts and fittings.
4. Sheet metal materials.
5. Duct liner.
6. Sealants and gaskets.
7. Hangers and supports.

- B. Related Sections:

1. Division 15 Section "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
2. Division 15 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
3. Division 15 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
4. Division 15 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing requirements for metal ducts.

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated.

1. Static-Pressure Classes:

- a. Supply Ducts (except in Mechanical Rooms): 2-inch wg.
- b. Supply Ducts (Upstream from Air Terminal Units): 3-inch wg.
- c. Supply Ducts (Downstream from Air Terminal Units): 1-inch wg.
- d. Supply Ducts (in Mechanical Equipment Rooms): 2-inch wg.
- e. Return Ducts (Negative Pressure): 1-inch wg.

- f. Exhaust Ducts (Negative Pressure): 1-inch wg.
- 2. Leakage Class:
  - a. Round Supply-Air Duct: 3 cfm/100 sq. ft. at 1-inch wg.
  - b. Flat-Oval Supply-Air Duct: 3 cfm/100 sq. ft. at 1-inch wg.
  - c. Rectangular Supply-Air Duct: 6 cfm/100 sq. ft. at 1-inch wg.
  - d. Flexible Supply-Air Duct: 6 cfm/100 sq. ft. at 1-inch wg.
- B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
  - 1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
  - 2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
  - 3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of the following products:
  - 1. Liners and adhesives.
  - 2. Sealants and gaskets.
  - 3. Seismic-restraint devices.
- B. Welding certificates.
- C. Field quality-control reports.

#### **1.5 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
  - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
  - 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

### **PART 2 - PRODUCTS**

#### **2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS**

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## **2.2 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS**

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Lindab Inc.
    - b. McGill AirFlow LLC.
    - c. SEMCO Incorporated.
    - d. Sheet Metal Connectors, Inc.
    - e. Spiral Manufacturing Co., Inc.
    - f. Metco.
    - g. Prior approved equal.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter (diameter of the round sides connecting the flat portions of the duct).
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct

and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
  2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## **2.3 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Lindab Inc.
  2. McGill AirFlow LLC.
  3. SEMCO Incorporated.
  4. Sheet Metal Connectors, Inc.
  5. Metco.
  6. Prior approved equal.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter (diameter of the round sides connecting the flat portions of the duct) of the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
    - a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
  2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
  - b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch-diameter perforations, with overall open area of 23 percent.
- E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
  1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
  3. Coat insulation with antimicrobial coating.
  4. Cover insulation with polyester film complying with UL 181, Class 1.

## **2.4 SHEET METAL MATERIALS**

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  1. Galvanized Coating Designation: G60.
  2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
  1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.5 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation; Insulation Group.
    - b. Johns Manville.
    - c. Knauf Insulation.
    - d. Owens Corning.
    - e. Prior approved equal.
    - f. Maximum Thermal Conductivity:
      - 1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
      - 2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  3. Solvent-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
- B. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
  2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
  3. Butt transverse joints without gaps, and coat joint with adhesive.
  4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
  - a. Fan discharges.
  - b. Intervals of lined duct preceding unlined duct.
  - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
  - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

## **2.6 SEALANT AND GASKETS**

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
  1. Application Method: Brush on.
  2. Solids Content: Minimum 65 percent.
  3. Shore A Hardness: Minimum 20.
  4. Water resistant.
  5. Mold and mildew resistant.
  6. VOC: Maximum 75 g/L (less water).
  7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  8. Service: Indoor or outdoor.
  9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- C. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
  2. Type: S.
  3. Grade: NS.
  4. Class: 25.
  5. Use: O.
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- E. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
  2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
  3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## **2.7 HANGERS AND SUPPORTS**

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

## **PART 3 - EXECUTION**

### **3.1 DUCT INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round and flat-oval ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 15 Section "Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

### **3.2 SEAM AND JOINT SEALING**

- A. Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA's "HVAC Duct

Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," unless otherwise indicated.

1. For static-pressure classes 1- and 1/2-inch wg, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Seal Class C, except as follows:
  - a. Ducts that are located directly in zones they serve.

### **3.3 HANGER AND SUPPORT INSTALLATION**

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  1. Where practical, install concrete inserts before placing concrete.
  2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
  5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### **3.4 CONNECTIONS**

- A. Make connections to equipment with flexible connectors complying with Division 15 Section "Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### **3.5 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Leakage Tests:
  - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual."
  - 2. Test the following systems:
    - a. Supply air.
  - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
  - 4. Test for leaks before insulation application.
  - 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
- C. Duct System Cleanliness Tests:
  - 1. Visually inspect duct system to ensure that no visible contaminants are present.
  - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
    - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

### **3.6 DUCT CLEANING**

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
  - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 15 Section "Duct Accessories" for access panels and doors.
  - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
  - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
  2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
1. Air outlets and inlets (registers, grilles, and diffusers).
  2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
  3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
  4. Coils and related components.
  5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
  6. Supply-air ducts, dampers, actuators, and turning vanes.
  7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
  2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
  3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
  4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
  5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
  6. Provide drainage and cleanup for wash-down procedures.
  7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

### **3.7 DUCT SCHEDULE**

- A. Fabricate ducts with galvanized sheet steel.
- B. Intermediate Reinforcement:
1. Galvanized-Steel Ducts: Galvanized steel.

C. Liner:

1. Supply- and Return-Air Ducts: Fibrous glass, Type I.

D. Double-Wall Duct Interstitial Insulation:

1. Supply- and Return-Air Ducts: 1 inch thick.

E. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
  - a. Velocity 1000 fpm or Lower:
    - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
    - 2) Mitered Type RE 4 without vanes.
  - b. Velocity 1000 to 1500 fpm:
    - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
    - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
    - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
  - c. Velocity 1500 fpm or Higher:
    - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
  - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
    - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
    - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.

3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.

- b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
- c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

F. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
  - a. Rectangular Main to Rectangular Branch: 45-degree entry.
  - b. Rectangular Main to Round Branch: Spin in.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
  - a. Velocity 1000 fpm or Lower: 90-degree tap.
  - b. Velocity 1000 to 1500 fpm: Conical tap.
  - c. Velocity 1500 fpm or Higher: 45-degree lateral.

G. Duct Schedule

1. Rectangular duct with liner:
  - a. Low pressure supply and return.
2. Rectangular duct wrapped with insulation:
  - a. Low pressure exhaust and fresh air.
3. Single wall round with wrapped insulation.
  - a. Low pressure supply and return.
4. Double wall round and flat oval:
  - a. Medium pressure supply (upstream of VAV).

END OF SECTION 15815

## **SECTION 15820 - DUCT ACCESSORIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Volume dampers.
  - 2. High Efficiency Take-Offs.
  - 3. Motorized control dampers.
  - 4. Turning vanes.
  - 5. Duct-mounting access doors.
  - 6. Flexible connectors.
  - 7. Flexible ducts.
  - 8. Duct accessory hardware.
- B. Related Sections include the following:
  - 1. Division 15 Section "HVAC Instrumentation and Controls" for electric and pneumatic damper actuators.

#### **1.3 SUBMITTALS**

- A. Product Data: For the following:
  - 1. Volume dampers.
  - 2. High Efficiency Take-Offs.
  - 3. Motorized control dampers.
  - 4. Turning vanes.
  - 5. Duct-mounting access doors.
  - 6. Flexible connectors.
  - 7. Flexible ducts.

#### **1.4 QUALITY ASSURANCE**

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

## **1.5 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### **2.2 SHEET METAL MATERIALS**

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G60 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

### **2.3 VOLUME DAMPERS**

- A. Manufacturers:
  - 1. Air Balance, Inc.
  - 2. American Warming and Ventilating.
  - 3. Flexmaster U.S.A., Inc.
  - 4. McGill AirFlow Corporation.
  - 5. METALAIRE, Inc.

6. Nailor Industries Inc.
  7. Penn Ventilation Company, Inc.
  8. Ruskin Company.
  9. Vent Products Company, Inc.
  10. Air Rite.
  11. Prior approved equal.
- B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
1. Pressure Classes of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.
- C. Standard Volume Dampers: Opposed-blade design, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
  2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized sheet steel.
  3. Aluminum Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
  4. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
  5. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
  6. Blade Axles: Galvanized steel.
  7. Bearings: Oil-impregnated bronze.
  8. Tie Bars and Brackets: Aluminum.
  9. Tie Bars and Brackets: Galvanized steel.
- D. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

## **2.4 HIGH EFFICIENCY TAKE-OFF**

- A. Factory-manufactured rectangular-to-round or round-to-round 45 degree leading tap fabricated of 24 ga zinc-coated lockforming quality steel sheets meeting requirements of ASTM A 653, with G-90 coating.
- B. One inch wide mounting flange with die formed corner clips, pre-punched mounting holes, and adhesive coated gasket.
- C. Manual Volume Damper:
1. Single blade, 22 ga minimum.

2. 3/8 inch minimum square rod with brass damper bearings at each end.
3. Heavy duty locking quadrant on 1-1/2 inch high stand-off mounting bracket attached to side of round duct.

D. Approved Manufacturers:

1. HETD-L by Daniel Manufacturing.
2. STO by Flexmaster USA Inc.
3. HET by Sheet Metal Connectors Inc.
4. Hercules.
5. Air-Rite.
6. Prior approved equal.

## **2.5 MOTORIZED CONTROL DAMPERS**

A. Manufacturers:

1. Air Balance, Inc.
2. American Warming and Ventilating.
3. CESCO Products.
4. Duro Dyne Corp.
5. Greenheck.
6. McGill AirFlow Corporation.
7. METALAIRE, Inc.
8. Nailor Industries Inc.
9. Penn Ventilation Company, Inc.
10. Ruskin Company.
11. Vent Products Company, Inc.
12. Air Rite.
13. Prior approved equal.

B. General Description: AMCA-rated, opposed-blade design; minimum of 0.1084-inch-thick, galvanized-steel frames with holes for duct mounting; minimum of 0.0635-inch-thick, galvanized-steel damper blades with maximum blade width of 8 inches.

1. Secure blades to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F.
3. Provide closed-cell neoprene edging.

## **2.6 TURNING VANES**

A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

- B. **Manufactured Turning Vanes:** Fabricate 1-1/2-inch- wide, single-vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.
  - 1. **Available Manufacturers:**
    - a. Ductmate Industries, Inc.
    - b. Duro Dyne Corp.
    - c. METALAIRE, Inc.
    - d. Ward Industries, Inc.
    - e. Prior approved equal.
- C. **Acoustic Turning Vanes:** Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

## **2.7 DUCT-MOUNTING ACCESS DOORS**

- A. **General Description:** Fabricate doors airtight and suitable for duct pressure class.
- B. **Door:** Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.
  - 1. **Manufacturers:**
    - a. American Warming and Ventilating.
    - b. CESCO Products.
    - c. Ductmate Industries, Inc.
    - d. Flexmaster U.S.A., Inc.
    - e. Greenheck.
    - f. McGill AirFlow Corporation.
    - g. Nailor Industries Inc.
    - h. Ventfabrics, Inc.
    - i. Ward Industries, Inc.
    - j. Air Rite.
    - k. Prior approved equal.
  - 2. **Frame:** Galvanized sheet steel, with bend-over tabs and foam gaskets.
  - 3. **Provide number of hinges and locks as follows:**
    - a. Less Than 12 Inches Square: Secure with two sash locks.
    - b. Up to 18 Inches Square: Two hinges and two sash locks.
    - c. Up to 24 by 48 Inches: Three hinges and two compression latches.
    - d. Sizes 24 by 48 Inches and Larger: One additional hinge.
- C. **Seal around frame attachment to duct and door to frame with neoprene or foam rubber.**
- D. **Insulation:** 1-inch- thick, fibrous-glass or polystyrene-foam board.

## **2.8 FLEXIBLE CONNECTORS**

- A. Manufacturers:
  - 1. Ductmate Industries, Inc.
  - 2. Duro Dyne Corp.
  - 3. Ventfabrics, Inc.
  - 4. Ward Industries, Inc.
  - 5. Prior approved equal.
- B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Select metal compatible with ducts.
- D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
  - 1. Minimum Weight: 26 oz./sq. yd..
  - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
  - 3. Service Temperature: Minus 40 to plus 200 deg F.
- E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
  - 1. Minimum Weight: 24 oz./sq. yd..
  - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
  - 3. Service Temperature: Minus 50 to plus 250 deg F.

## **2.9 FLEXIBLE DUCTS**

- A. Manufacturers:
  - 1. Flexmaster U.S.A., Inc.
  - 2. Hart & Cooley, Inc.
  - 3. McGill AirFlow Corporation.
  - 4. Themaflex.
  - 5. Prior approved equal.
- B. Insulated-Duct Connectors: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor barrier film.
  - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
  - 2. Maximum Air Velocity: 4000 fpm.
  - 3. Temperature Range: Minus 20 to plus 210 deg F.
- C. Flexible Duct Clamps: Nylon strap, in sizes 3 through 18 inches to suit duct size.

## **2.10 DUCT ACCESSORY HARDWARE**

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

## **PART 3 - EXECUTION**

### **3.1 APPLICATION AND INSTALLATION**

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- D. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.
- E. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.
- F. Provide test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers, with fusible links, according to manufacturer's UL-approved written instructions.
- H. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:
  - 1. On both sides of duct coils.
  - 2. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.
  - 3. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot spacing.
  - 4. On sides of ducts where adequate clearance is available.
- I. Install the following sizes for duct-mounting, rectangular access doors:
  - 1. One-Hand or Inspection Access: 8 by 5 inches.
  - 2. Two-Hand Access: 12 by 6 inches.

3. Head and Hand Access: 18 by 10 inches.
  4. Head and Shoulders Access: 21 by 14 inches.
  5. Body Access: 25 by 14 inches.
  6. Body Plus Ladder Access: 25 by 17 inches.
- J. Install the following sizes for duct-mounting, round access doors:
1. One-Hand or Inspection Access: 8 inches in diameter.
  2. Two-Hand Access: 10 inches in diameter.
  3. Head and Hand Access: 12 inches in diameter.
  4. Head and Shoulders Access: 18 inches in diameter.
  5. Body Access: 24 inches in diameter.
- K. Label access doors according to Division 15 Section "Mechanical Identification."
- L. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
- M. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- N. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- O. Connect diffusers to low pressure ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- P. Connect flexible ducts to metal ducts with draw bands.
- Q. Install duct test holes where indicated and required for testing and balancing purposes.

### **3.2 ADJUSTING**

- A. Adjust duct accessories for proper settings.
- B. Adjust fire and smoke dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Division 15 Section "Testing, Adjusting, and Balancing."

END OF SECTION 15820

## **SECTION 15840 - AIR TERMINAL UNITS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Shutoff single-duct air terminal units.

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated, include rated capacities, furnished specialties, sound-power ratings, and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Include a schedule showing unique model designation, room location, model number, size, and accessories furnished.
  - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Procedures," include the following:
  - 1. Instructions for resetting minimum and maximum air volumes.
  - 2. Instructions for adjusting software set points.

#### **1.4 QUALITY ASSURANCE**

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air terminal units and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- C. NFPA Compliance: Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

## **1.5 COORDINATION**

- A. Coordinate layout and installation of air terminal units and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### **2.2 SHUTOFF SINGLE-DUCT AIR TERMINAL UNITS**

- A. Manufacturers:
  - 1. Carnes.
  - 2. Krueger.
  - 3. METALAIR, Inc.; Metal Industries Inc.
  - 4. Nailor Industries of Texas Inc.
  - 5. Price Industries.
  - 6. Titus.
  - 7. Tuttle & Bailey.
- B. Configuration: Volume-damper assembly inside unit casing with control components located inside a protective metal shroud.
- C. Casing: 0.034-inch steel.
  - 1. Casing Lining: 1-inch- thick, coated, fibrous-glass duct liner complying with ASTM C 1071; secured with adhesive.
  - 2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
  - 3. Air Outlet: S-slip and drive connections.
  - 4. Access: Removable panels for access to dampers and other parts requiring service, adjustment, or maintenance; with airtight gasket.

- D. Regulator Assembly: Extruded-aluminum or galvanized-steel components; key damper blades onto shaft with nylon-fitted pivot points located inside unit casing.
  - 1. Automatic Flow-Control Assembly: Combined spring rates shall be matched for each volume-regulator size with machined dashpot for stable operation.
  - 2. Factory-calibrated and field-adjustable assembly with shaft extension for connection to externally mounted control actuator.
- E. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
  - 1. Maximum Damper Leakage: ARI 880 rated, 3 percent of nominal airflow at 3-inch wg inlet static pressure.
  - 2. Damper Position: Normally open.
- F. Hot-Water Heating Coil: Copper tube, mechanically expanded into aluminum-plate fins; leak tested underwater to 200 psig; and factory installed.
- G. DDC Controls: Bidirectional damper operators and microprocessor-based controller and room sensor shall be compatible with temperature controls specified in Division 15 Section "HVAC Instrumentation and Controls" and shall have the following features:
  - 1. Damper Actuator: 24 V, powered closed, spring return open.
  - 2. Terminal Unit Controller: Pressure-independent, variable-air-volume controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:
    - a. Proportional, plus integral control of room temperature.
    - b. Time-proportional reheat-coil control.
    - c. Occupied and unoccupied operating mode.
    - d. Remote reset of airflow or temperature set points.
    - e. Adjusting and monitoring with portable terminal.
    - f. Communication with temperature-control system specified in Division 15 Section "HVAC Instrumentation and Controls."
  - 3. Room Sensor: Wall mounting, with temperature set-point adjustment and access for connection of portable operator terminal.
- H. Control Sequence:
  - 1. Suitable for operation with duct pressures between 0.25- and 3.0-inch wg inlet static pressure.
  - 2. Factory-mounted and -piped, 5-micron filter; velocity-resetting, adjustable, high-limit control; and amplifying relay.
  - 3. System-powered, wall-mounting thermostat.

## **2.3 SOURCE QUALITY CONTROL**

- A. Identification: Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

- B. Verification of Performance: Rate air terminal units according to ARI 880.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

### **3.2 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to air terminal units to allow service and maintenance.
- C. Hot-Water Piping: In addition to requirements in Division 15 Section "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- D. Connect ducts to air terminal units according to Division 15 Section "Metal Ducts."
- E. Connect wiring according to Division 16 Section "Conductors and Cables."
- F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### **3.3 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
  - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
  - 2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

### **3.4      STARTUP SERVICE**

- A.    Engage a factory-authorized service representative to perform startup service.
  - 1.    Complete installation and startup checks according to manufacturer's written instructions and do the following:
    - a.    Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
    - b.    Verify that controls and control enclosure are accessible.
    - c.    Verify that control connections are complete.
    - d.    Verify that nameplate and identification tag are visible.
    - e.    Verify that controls respond to inputs as specified.

### **3.5      DEMONSTRATION**

- A.    Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units. Refer to Division 1 Section "Closeout Procedures."

END OF SECTION 15840

## **SECTION 15855 - DIFFUSERS, REGISTERS, AND GRILLES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.
- B. Related Sections include the following:
  - 1. Division 15 Section "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

#### **1.3 SUBMITTALS**

- A. Product Data: For each product indicated, include the following:
  - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
  - 2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Products: Subject to compliance with requirements, provide one of the products specified.

#### **2.2 GRILLES AND REGISTERS**

- A. Fixed Face Ceiling Return, Exhaust, or Transfer Air Grille:
  - 1. Products:
    - a. Carnes; RSL4.

- b. Krueger; S85H.
  - c. Price Industries; 535.
  - d. Titus; 355RL.
  - e. Tuttle & Bailey; T70D.
  - f. Or equal by:
    - 1) A-J Manufacturing Co., Inc.
    - 2) Anemostat; a Mestek Company.
    - 3) Dayus Register & Grille.
    - 4) Hart & Cooley, Inc.; Hart & Cooley Div.
    - 5) Nailor Industries of Texas Inc.
- 2. Material: Steel.
  - 3. Finish: Baked enamel, white.
  - 4. Face Arrangement: 1/2 inch horizontal blade spacing.
  - 5. Frame: 1-1/4 inches wide.

## **2.3 CEILING DIFFUSER OUTLETS**

### **A. Rectangular and Square Ceiling Diffusers:**

- 1. Products:
  - a. Carnes; SKSA.
  - b. Krueger; SH.
  - c. METALAIRE, Inc., Metal Industries Inc.; 55005.
  - d. Price Industries; SMD.
  - e. Titus; TDC.
  - f. Tuttle & Bailey; MS.
  - g. Or equal by:
    - 1) A-J Manufacturing Co., Inc.
    - 2) Anemostat; a Mestek Company.
    - 3) Hart & Cooley, Inc.; Hart & Cooley Div.
    - 4) Nailor Industries of Texas Inc.
- 2. Material: Steel.
- 3. Finish: Baked enamel, white.

## **2.4 SOURCE QUALITY CONTROL**

- ### **A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."**

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, provide lay-in ceiling module. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### **3.3 ADJUSTING**

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 15855

## **SECTION 15900 - HVAC INSTRUMENTATION AND CONTROLS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes new control equipment required for the upgrade of the Second Floor HVAC system and components, including control components for terminal heating units and the upgrade of the heating hot water system.
- B. Related Sections include the following:
  - 1. Division 15 Section "Meters and Gages" for measuring equipment that relates to this Section.
  - 2. Division 15 Section "Sequence of Operation" for requirements that relate to this Section.
- C. The DDC system, front end, etc. is existing TAC/INET by Utah Controls.

#### **1.3 SCOPE OF WORK:**

- A. The scope of work shall include all labor, material, and equipment necessary to re-commission the DDC controls and extend the existing Tour Andover Controls (TAC) INET temperature control system. The original building sequence of operation shall be re-used and give general guidelines for the equipment to be controlled. It shall be the ATC contractor responsibility to completely re-commission the existing control system and extend the TAC INET control system to all equipment related to this specification.
- B. The temperature controls shall be installed and certified by the ATC contractor utilizing TAC Controls (INET-Seven) as specified. The installation of the DDC system must be approved and certified by the controls manufacturer.
- C. Install a new Direct Digital Control (DDC) system to be tied into the existing Host Computer. This DDC System shall operate over the owners WAN Network and shall include a Web Server to allow the control system to be viewed and controlled by a standard Web browser.
- D. This system shall include, but not are limited to, controls and equipment as hereinafter specified:

- E. This system shall include but not be limited to controls and equipment as hereinafter specified.
  - 1. VAV Boxes
  - 2. Perimeter hot water baseboard.
- F. The Temperature Control Contractor under this section shall provide all control equipment hereinafter specified.
- G. All Control equipment shall be manufactured by the temperature control companies listed in the bidding section of these documents.

#### **1.4 DEFINITIONS**

- A. DDC: Direct digital control.
- B. I/O: Input/output.
- C. MS/TP: Master slave/token passing.
- D. PC: Personal computer.
- E. PID: Proportional plus integral plus derivative.
- F. RTD: Resistance temperature detector.

#### **1.5 SYSTEM PERFORMANCE**

- A. Comply with the following performance requirements:
  - 1. Upgrade existing graphic display as required to mach modifications and changes.
  - 2. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
  - 3. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
    - a. Water Temperature: Plus or minus 1 deg F.
    - b. Water Flow: Plus or minus 5 percent of full scale.
    - c. Water Pressure: Plus or minus 2 percent of full scale.
    - d. Space Temperature: Plus or minus 1 deg F.
    - e. Ducted Air Temperature: Plus or minus 1 deg F.
    - f. Outside Air Temperature: Plus or minus 2 deg F.
    - g. Dew Point Temperature: Plus or minus 3 deg F.
    - h. Temperature Differential: Plus or minus 0.25 deg F.
    - i. Relative Humidity: Plus or minus 5 percent.
    - j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
    - k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
    - l. Airflow (Terminal): Plus or minus 10 percent of full scale.
    - m. Air Pressure (Space): Plus or minus 0.01-inch wg.

- n. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
- o. Carbon Monoxide: Plus or minus 5 percent of reading.
- p. Carbon Dioxide: Plus or minus 50 ppm.
- q. Electrical: Plus or minus 5 percent of reading.

## **1.6 SEQUENCE OF OPERATION**

- A. Shall be the same as existing.

## **1.7 SUBMITTALS**

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
  - 1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, and relays/switches.
  - 2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
  - 3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
  - 2. Schematic flow diagrams showing pumps, coils, dampers, valves, and control devices.
  - 3. Wiring Diagrams: Power, signal, and control wiring.
  - 4. Written description of sequence of operation.
  - 5. Schedule of dampers including size, leakage, and flow characteristics.
  - 6. Schedule of valves including flow characteristics.
  - 7. DDC System Hardware:
    - a. Wiring diagrams for control units with termination numbers.
    - b. Schematic diagrams and floor plans for field sensors and control hardware.
    - c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
  - 8. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.

- 9. Controlled Systems:
  - a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
  - b. Points list.
- C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.
- D. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with Existing System.
- E. Samples for Initial Selection: For each color required, of each thermostat cover with factory-applied color finishes.
- F. Software and Firmware Operational Documentation: Include the following:
  - 1. Software operating and upgrade manuals.
- G. Software Upgrade Kit: For Owner to use in modifying software to suit new remodel revisions.
- H. Qualification Data: For Installer.
  - 1. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals.

## **1.8 QUALITY ASSURANCE**

- A. Installer Qualifications: Utah Controls Inc. (no exceptions) Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with ASHRAE 135 for DDC system components.

## **1.9 COORDINATION**

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### **2.2 CONTROL SYSTEM**

- A. Manufacturers:
  - 1. **TAC/INET by Utah Controls. (no exceptions)**
- B. Control system shall consist of thermostats, automatic valves, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control remodeled mechanical systems.
- C. Control is existing and shall be modified to fit new mechanical upgrade.

### **2.3 DDC EQUIPMENT**

- A. Operator Workstation: Existing.
  - 1. Operating System: Existing.
  - 2. Printer: Existing.
  - 3. Application Software:
    - a. Existing must be updated for new mechanical modifications.
  - 4. Custom Application Software:
    - a. Existing.
    - b. Full-screen character editor/programming environment.
    - c. Allow development of independently executing program modules with debugging/simulation capability.
    - d. Support conditional statements.
    - e. Support floating-point arithmetic with mathematic functions.
    - f. Contains predefined time variables.
- B. Diagnostic Terminal Unit:
  - 1. Existing.
- C. Control Units:

- 1. Existing to be modified.
- D. Local Control Units:
  - 1. Existing.
- E. I/O Interface:
  - 1. Existing to be modified.

## **2.4 UNITARY CONTROLLERS**

- A. Existing to be modified.

## **2.5 ALARM PANELS**

- A. Existing.

## **2.6 ANALOG CONTROLLERS**

- A. Existing.

## **2.7 ELECTRONIC SENSORS**

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. Thermistor Temperature Sensors and Transmitters:
  - 1. Accuracy: Plus or minus 0.5 deg F at calibration point.
  - 2. Wire: Twisted, shielded-pair cable.
  - 3. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
  - 4. Averaging Elements in Ducts: 36 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft.
  - 5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
  - 6. Room Sensor Cover Construction: Manufacturer's standard locking covers.
    - a. Set-Point Adjustment: Concealed.
    - b. Set-Point Indication: Exposed.
    - c. Color: Match existing.

## 2.8 ACTUATORS

- A. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
1. Manufacturers:
    - a. Belimo Aircontrols (USA), Inc.
    - b. TAC
    - c. Prior approved equal.
  2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
  3. Dampers: Size for running torque calculated as follows:
    - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
    - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
    - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
    - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
    - e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
    - f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
  4. Coupling: V-bolt and V-shaped, toothed cradle.
  5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
  6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
  7. Power Requirements (Two-Position Spring Return): 24-V ac.
  8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
  9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
  10. Temperature Rating: Minus 22 to plus 122 deg F.
  11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.
  12. Run Time: 12 seconds open, 5 seconds closed.

## 2.9 CONTROL VALVES

- A. Manufacturers:
1. TAC
  2. Erie Controls.
  3. Belimo
  4. Magnatrol Valve Corporation.
  5. Neles-Jamesbury.
  6. Parker Hannifin Corporation; Skinner Valve Division.
  7. Pneuline Controls.
  8. Sauter Controls Corporation.

9. Prior approved equal.
- B. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
- C. Hydronic system globe valves shall have the following characteristics:
  1. NPS 2 and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
  2. NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
  3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
    - a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
    - b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
  4. Sizing: 3-psig maximum pressure drop at design flow rate or the following:
    - a. Two Position: Line size.
    - b. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
    - c. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.
  5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
  6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.
- D. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
  1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
  2. Sizing: 3-psig maximum pressure drop at design flow rate, to close against pump shutoff head.
  3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

## 2.10 DAMPERS

- A. Manufacturers:
  1. Air Balance Inc.
  2. Delta

3. TAMCO (T. A. Morrison & Co. Inc.).
  4. United Enertech Corp.
  5. Vent Products Company, Inc.
  6. Ruskin.
  7. Prior approved equal.
- B. Dampers: AMCA-rated, opposed-blade design; 0.108-inch- minimum thick, galvanized-steel or 0.125-inch- minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.
1. Secure blades to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
  2. Operating Temperature Range: From minus 40 to plus 200 deg F.
  3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
  4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500D.

## **2.11 CONTROL CABLE**

- A. Electronic and fiber-optic cables for control wiring are specified in Division 16 Section "Voice and Data Communication Cabling."

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that power supply is available to control units and operator workstation.
- B. Verify that pneumatic piping and duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

### **3.2 INSTALLATION**

- A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- B. Connect and configure equipment and software to achieve sequence of operation specified.
- C. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- D. Install guards on thermostats in the following locations:
  1. Entrances.
  2. Public areas.
  3. Where indicated.
- E. Install automatic dampers according to Division 15 Section "Duct Accessories."
- F. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- G. Install labels and nameplates to identify control components according to Division 15 Section "Mechanical Identification."
- H. Install hydronic instrument wells, valves, and other accessories according to Division 15 Section "Hydronic Piping."
- I. Install duct volume-control dampers according to Division 15 Sections specifying air ducts.
- J. Install electronic and fiber-optic cables according to Division 16 Section "Voice and Data Communication Cabling."

### **3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION**

- A. Install raceways, boxes, and cabinets according to Division 16 Section "Raceways and Boxes."
- B. Install building wire and cable according to Division 16 Section "Conductors and Cables."
- C. Install signal and communication cable according to Division 16 Section "Voice and Data Communication Cabling."
  1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
  2. Install exposed cable in raceway.
  3. Install concealed cable in raceway.
  4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
  5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
  6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
  7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

### **3.4 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
  - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
  - 2. Test and adjust controls and safeties.
  - 3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 4. Pressure test control air piping at 30 psig or 1.5 times the operating pressure for 24 hours, with maximum 5-psig loss.
  - 5. Pressure test high-pressure control air piping at 150 psig and low-pressure control air piping at 30 psig for 2 hours, with maximum 1-psig loss.
  - 6. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
  - 7. Test each point through its full operating range to verify that safety and operating control set points are as required.
  - 8. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
  - 9. Test each system for compliance with sequence of operation.
  - 10. Test software and hardware interlocks.
- C. DDC Verification:
  - 1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
  - 2. Check instruments for proper location and accessibility.
  - 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
  - 4. Check instrument tubing for proper fittings, slope, material, and support.
  - 5. Check installation of air supply for each instrument.
  - 6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
  - 7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
  - 8. Check temperature instruments and material and length of sensing elements.
  - 9. Check control valves. Verify that they are in correct direction.

10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
  11. Check DDC system as follows:
    - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    - c. Verify that spare I/O capacity has been provided.
    - d. Verify that DDC controllers are protected from power supply surges.
- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

### 3.5 ADJUSTING

- A. Calibrating and Adjusting:
1. Calibrate instruments.
  2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
  3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
  4. Control System Inputs and Outputs:
    - a. Check analog inputs at 0, 50, and 100 percent of span.
    - b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
    - c. Check digital inputs using jumper wire.
    - d. Check digital outputs using ohmmeter to test for contact making or breaking.
    - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
  5. Flow:
    - a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
    - b. Manually operate flow switches to verify that they make or break contact.
  6. Pressure:
    - a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
    - b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
  7. Temperature:

- a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
    - b. Calibrate temperature switches to make or break contacts.
  8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
  9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
  10. Provide diagnostic and test instruments for calibration and adjustment of system.
  11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.
- B. Adjust initial temperature and humidity set points.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.
- D. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 15900

## **SECTION 15950 - TESTING, ADJUSTING, AND BALANCING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes TAB to produce design objectives for the following:
  - 1. Air Systems:
    - a. Constant-volume air systems.
    - b. Variable-air-volume systems.
  - 2. Hydronic Piping Systems:
    - a. Constant-flow systems.
    - b. Variable-flow systems.
  - 3. Existing systems TAB.
  - 4. Verifying that automatic control devices are functioning properly.
  - 5. Reporting results of activities and procedures specified in this Section.

#### **1.3 DEFINITIONS**

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- E. NC: Noise criteria.

- F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- G. RC: Room criteria.
- H. Report Forms: Test data sheets for recording test data in logical order.
- I. Smoke-Control System: An engineered system that uses fans to produce airflow and pressure differences across barriers to limit smoke movement.
- J. Smoke-Control Zone: A space within a building that is enclosed by smoke barriers and is a part of a zoned smoke-control system.
- K. Stair Pressurization System: A type of smoke-control system that is intended to positively pressurize stair towers with outdoor air by using fans to keep smoke from contaminating the stair towers during an alarm condition.
- L. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- M. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- N. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- O. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- P. TAB: Testing, adjusting, and balancing.
- Q. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- R. Test: A procedure to determine quantitative performance of systems or equipment.
- S. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

#### **1.4 SUBMITTALS**

- A. Qualification Data: Within 15 days from Contractor's Notice to Proceed, submit 4 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of the Contract Documents review report as specified in Part 3.

- C. Strategies and Procedures Plan: Within 60 days from Contractor's Notice to Proceed, submit 4 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- D. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- E. Sample Report Forms: Submit two sets of sample TAB report forms.
- F. Warranties specified in this Section.

## **1.5 QUALITY ASSURANCE**

- A. TAB Firm Qualifications: Engage a TAB firm certified by AABC or NEBB.
- B. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.
  - 1. Agenda Items: Include at least the following:
    - a. Submittal distribution requirements.
    - b. The Contract Documents examination report.
    - c. TAB plan.
    - d. Work schedule and Project-site access requirements.
    - e. Coordination and cooperation of trades and subcontractors.
    - f. Coordination of documentation and communication flow.
- C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
  - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
  - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- D. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
- E. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

- F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
  - 1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.
- G. Approved TAB agencies:
  - 1. Bonneville Test and Balance.
  - 2. BTC Services.
  - 3. Certified Test and Balance.
  - 4. Danis Test and Balance.
  - 5. Intermountain Test and Balance.
  - 6. RS Analysis.
  - 7. Technical Specialties.
  - 8. Testing and Balancing, Inc.

## **1.6 PROJECT CONDITIONS**

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

## **1.7 COORDINATION**

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

## **1.8 WARRANTY**

- A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

## **PART 2 - PRODUCTS**

(Not Applicable)

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
  1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
  2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine Project Record Documents described in Division 1 Section "Project Record Documents."
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- G. Examine system and equipment test reports.

- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
- L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- M. Examine strainers for clean screens and proper perforations.
- N. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- P. Examine system pumps to ensure absence of entrained air in the suction piping.
- Q. Examine equipment for installation and for properly operating safety interlocks and controls.
- R. Examine automatic temperature system components to verify the following:
  - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
  - 2. Dampers and valves are in the position indicated by the controller.
  - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
  - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
  - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
  - 6. Sensors are located to sense only the intended conditions.
  - 7. Sequence of operation for control modes is according to the Contract Documents.
  - 8. Controller set points are set at indicated values.
  - 9. Interlocked systems are operating.
  - 10. Changeover from heating to cooling mode occurs according to indicated values.

- S. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### **3.2 PREPARATION**

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
  - 1. Permanent electrical power wiring is complete.
  - 2. Hydronic systems are filled, clean, and free of air.
  - 3. Automatic temperature-control systems are operational.
  - 4. Equipment and duct access doors are securely closed.
  - 5. Balance, smoke, and fire dampers are open.
  - 6. Isolating and balancing valves are open and control valves are operational.
  - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
  - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

### **3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING**

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### **3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS**

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.

- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling unit components.
- L. Check for proper sealing of air duct system.

### **3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS**

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure fan static pressures to determine actual static pressure as follows:
    - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet or through the flexible connection.
    - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
    - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
  - 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
  - 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.

4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
  5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
  6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
    - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
  2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
  2. Adjust patterns of adjustable outlets for proper distribution without drafts.

### **3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS**

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.

- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
  2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
  3. Measure total system airflow. Adjust to within indicated airflow.
  4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
  5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
    - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
  6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
  7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
  8. Record the final fan performance data.

### **3.7 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS**

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

### **3.8 PROCEDURES FOR HEAT-TRANSFER COILS**

- A. Water Coils: Measure the following data for each coil:
1. Entering- and leaving-water temperature.
  2. Water flow rate.
  3. Water pressure drop.
  4. Dry-bulb temperature of entering and leaving air.
  5. Wet-bulb temperature of entering and leaving air for cooling coils.
  6. Airflow.
  7. Air pressure drop.

### **3.9 PROCEDURES FOR TEMPERATURE MEASUREMENTS**

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

### **3.10 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS**

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
  - 1. Measure and record the operating speed, airflow, and static pressure of each fan.
  - 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
  - 3. Check the refrigerant charge.
  - 4. Check the condition of filters.
  - 5. Check the condition of coils.
  - 6. Check the operation of the drain pan and condensate drain trap.
  - 7. Check bearings and other lubricated parts for proper lubrication.
  - 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished.
  - 1. New filters are installed.
  - 2. Coils are clean and fins combed.
  - 3. Drain pans are clean.
  - 4. Fans are clean.
  - 5. Bearings and other parts are properly lubricated.
  - 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
  - 1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan, speed, filter, and coil face velocity.
  - 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.

3. If calculations increase or decrease the airflow and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated airflow and water flow rates. If 5 percent or less, equipment adjustments are not required.
4. Air balance each air outlet.

### **3.11 TEMPERATURE-CONTROL VERIFICATION**

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.
- I. Check main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

### **3.12 TOLERANCES**

- A. Set HVAC system airflow and water flow rates within the following tolerances:
  1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
  2. Air Outlets and Inlets: 0 to minus 10 percent.
  3. Heating-Water Flow Rate: 0 to minus 10 percent.
  4. Cooling-Water Flow Rate: 0 to minus 5 percent.

### **3.13 REPORTING**

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

### **3.14 FINAL REPORT**

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
  - 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
  - 1. Manufacturers' test data.
  - 2. Field test reports prepared by system and equipment installers.
  - 3. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
  - 1. Title page.
  - 2. Name and address of TAB firm.
  - 3. Project name.
  - 4. Project location.
  - 5. Architect's name and address.
  - 6. Engineer's name and address.
  - 7. Contractor's name and address.
  - 8. Report date.
  - 9. Signature of TAB firm who certifies the report.
  - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  - 11. Summary of contents including the following:
    - a. Indicated versus final performance.

- b. Notable characteristics of systems.
  - c. Description of system operation sequence if it varies from the Contract Documents.
- 12. Nomenclature sheets for each item of equipment.
- 13. Data for terminal units, including manufacturer, type size, and fittings.
- 14. Notes to explain why certain final data in the body of reports varies from indicated values.
- 15. Test conditions for fans and pump performance forms including the following:
  - a. Settings for outside-, return-, and exhaust-air dampers.
  - b. Conditions of filters.
  - c. Cooling coil, wet- and dry-bulb conditions.
  - d. Face and bypass damper settings at coils.
  - e. Fan drive settings including settings and percentage of maximum pitch diameter.
  - f. Inlet vane settings for variable-air-volume systems.
  - g. Settings for supply-air, static-pressure controller.
  - h. Other system operating conditions that affect performance.
- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
  - 1. Quantities of outside, supply, return, and exhaust airflows.
  - 2. Water and steam flow rates.
  - 3. Duct, outlet, and inlet sizes.
  - 4. Pipe and valve sizes and locations.
  - 5. Terminal units.
  - 6. Balancing stations.
  - 7. Position of balancing devices.
- F. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
  - 1. Report Data:
    - a. System and air-handling unit number.
    - b. Location and zone.
    - c. Traverse air temperature in deg F.
    - d. Duct static pressure in inches wg.
    - e. Duct size in inches.
    - f. Duct area in sq. ft..
    - g. Indicated airflow rate in cfm.
    - h. Indicated velocity in fpm.
    - i. Actual airflow rate in cfm.
    - j. Actual average velocity in fpm.
    - k. Barometric pressure in psig.
- G. Air-Terminal-Device Reports:

1. Unit Data:
    - a. System and air-handling unit identification.
    - b. Location and zone.
    - c. Test apparatus used.
    - d. Area served.
    - e. Air-terminal-device make.
    - f. Air-terminal-device number from system diagram.
    - g. Air-terminal-device type and model number.
    - h. Air-terminal-device size.
    - i. Air-terminal-device effective area in sq. ft..
  2. Test Data (Indicated and Actual Values):
    - a. Airflow rate in cfm.
    - b. Air velocity in fpm.
    - c. Preliminary airflow rate as needed in cfm.
    - d. Preliminary velocity as needed in fpm.
    - e. Final airflow rate in cfm.
    - f. Final velocity in fpm.
    - g. Space temperature in deg F.
- H. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
1. Unit Data:
    - a. System and air-handling unit identification.
    - b. Location and zone.
    - c. Room or riser served.
    - d. Coil make and size.
    - e. Flowmeter type.
  2. Test Data (Indicated and Actual Values):
    - a. Airflow rate in cfm.
    - b. Entering-water temperature in deg F.
    - c. Leaving-water temperature in deg F.
    - d. Water pressure drop in feet of head or psig.
    - e. Entering-air temperature in deg F.
    - f. Leaving-air temperature in deg F.
- I. Instrument Calibration Reports:
1. Report Data:
    - a. Instrument type and make.
    - b. Serial number.
    - c. Application.
    - d. Dates of use.
    - e. Dates of calibration.

### **3.15 INSPECTIONS**

#### **A. Initial Inspection:**

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
2. Randomly check the following for each system:
  - a. Measure airflow of at least 10 percent of air outlets.
  - b. Measure water flow of at least 5 percent of terminals.
  - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
  - d. Measure sound levels at two locations.
  - e. Measure space pressure of at least 10 percent of locations.
  - f. Verify that balancing devices are marked with final balance position.
  - g. Note deviations to the Contract Documents in the Final Report.

#### **B. Final Inspection:**

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect.
3. Architect shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

### **3.16 ADDITIONAL TESTS**

- #### **A.**
- Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 15950

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## SECTION 16051- COMMON WORK RESULTS FOR ELECTRICAL

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Electrical equipment coordination and installation.
  - 2. Sleeves for raceways and cables.
  - 3. Sleeve seals.
  - 4. Grout.
  - 5. Common electrical installation requirements.

#### 1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

#### 1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."

- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

## PART 2 - PRODUCTS

### 2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
  - 1. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
    - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

### 2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  - 3. Pressure Plates: Plastic Include two for each sealing element.
  - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

### 2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## PART 3 - EXECUTION

### 3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

### 3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors **2 inches (50 mm)** above finished floor level.
- G. Size pipe sleeves to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
  - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 7 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."

- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

### 3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Through-Penetration Firestop Systems."

END OF SECTION 16051

## SECTION 16053- COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Electronic safety and security equipment coordination and installation.
  - 2. Sleeves for raceways and cables.
  - 3. Sleeve seals.
  - 4. Grout.
  - 5. Common electronic safety and security installation requirements.

#### 1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

#### 1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."

- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

## PART 2 - PRODUCTS

### 2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel.
  - 1. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
    - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

### 2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  - 3. Pressure Plates: Plastic Include two for each sealing element.
  - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

### 2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## PART 3 - EXECUTION

### 3.1 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATION

- A. Comply with NECA 1.

- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

### 3.2 SLEEVE INSTALLATION FOR ELECTRONIC SAFETY AND SECURITY PENETRATIONS

- A. Electronic safety and security penetrations occur when raceways, pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors **2 inches (50 mm)** above finished floor level.
- G. Size pipe sleeves to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
  - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 7 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for **1-inch (25-mm)** annular clear space between pipe and sleeve for installing mechanical sleeve seals.

- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

### 3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electronic safety and security installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Through-Penetration Firestop Systems."

END OF SECTION 16053

## SECTION 16074- VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Isolation pads.
  - 2. Spring isolators.
  - 3. Restrained spring isolators.
  - 4. Channel support systems.
  - 5. Restraint cables.
  - 6. Hanger rod stiffeners.
  - 7. Anchorage bushings and washers.
- B. Related Sections include the following:
  - 1. Division 16 Section "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

#### 1.3 DEFINITIONS

- A. The IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
  - 1. Site Class as Defined in the IBC: Refer to structural specification
  - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: III

#### 1.5 SUBMITTALS

- A. Product Data: For the following:
  - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
  - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

- a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES
      - b. Annotate to indicate application of each product submitted and compliance with requirements.
    3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.
  - B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
    1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.
      - a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Division 16 Sections for equipment mounted outdoors.
    2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
    3. Field-fabricated supports.
    4. Seismic-Restraint Details:
      - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
      - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
  - C. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.
  - D. Welding certificates.
  - E. Field quality-control test reports.
- 1.6 QUALITY ASSURANCE
- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
  - B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
  - D. Comply with NFPA 70.

## PART 2 - PRODUCTS

### 2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Isolation Technology, Inc.
5. Kinetics Noise Control.
6. Mason Industries.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc.

### 2.2 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Cooper B-Line, Inc.; a division of Cooper Industries.
4. Hilti Inc.
5. Loos & Co.; Seismic Earthquake Division.
6. Mason Industries.
7. TOLCO Incorporated; a brand of NIBCO INC.
8. Unistrut; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an evaluation service member of ICC-ES

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. Restraint Cables: ASTM A 603 galvanized steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Do not weld stiffeners to rods.

F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.

G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.

- H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

## 2.3 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
  - 1. Powder coating on springs and housings.
  - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
  - 3. Baked enamel or powder coat for metal components on isolators for interior use.
  - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an evaluation service member of ICC-ES
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

### 3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

#### A. Equipment and Hanger Restraints:

1. Install restrained isolators on electrical equipment.
2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.

#### B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

#### C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

#### D. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

### 3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- #### A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

### 3.5 FIELD QUALITY CONTROL

- #### A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

#### B. Perform tests and inspections.

#### C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.

3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

### 3.6 ADJUSTING

- A. Adjust isolators after isolated equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 16074

## SECTION 16120- CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.
  - 3. Sleeves and sleeve seals for cables.
- B. Related Sections include the following:
  - 1. Division 16 Section "Voice and Data Communication Cabling" for cabling used for voice and data circuits.
  - 2. Division 16 Section "Undercarpet Cables" for flat cables for undercarpet installations.
  - 3. Division 16 Section "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 2001 to 35,000 V.

#### 1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For testing agency.
- C. Field quality-control test reports.

#### 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

## 1.6 COORDINATION

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

## PART 2 - PRODUCTS

### 2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Alcan Products Corporation; Alcan Cable Division.
  - 2. American Insulated Wire Corp.; a Leviton Company.
  - 3. General Cable Corporation.
  - 4. Senator Wire & Cable Company.
  - 5. Southwire Company.
  - 6.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN

### 2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Hubbell Power Systems, Inc.
  - 3. O-Z/Gedney; EGS Electrical Group LLC.
  - 4. 3M; Electrical Products Division.
  - 5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

### 2.3 SLEEVES FOR CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum ~~0.052-~~ or ~~0.138-inch~~ (1.3- or 3.5-mm) thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

### 2.4 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.

### PART 3 - EXECUTION

#### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper for feeders smaller than No. 4 AWG; copper or aluminum for panel feeders No. 4 AWG and larger]. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

#### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-THWN, single conductors in raceway
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway
- E. Feeders Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway
- F. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway
- G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway or Metal-clad cable- Type MC as indicated on the drawings
- H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway
- I. Branch Circuits Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway
- J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- K. Class 1 Control Circuits: Type THHN-THWN, in raceway.

#### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 16 Section "Electrical Supports and Seismic Restraints."
- F. Identify and color-code conductors and cables according to Division 16 Section "Electrical Identification."

### 3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least [6 inches (150 mm)] [12 inches (300 mm)] of slack.

### 3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
  - 1. For sleeve rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
  - 2. For sleeve rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both wall surfaces.
- G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and cable unless sleeve seal is to be installed
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies

- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 7 Section "Joint Sealants."
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 7 Section "Through-Penetration Firestop Systems."
- L. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- M. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between cable and sleeve for installing mechanical sleeve seals.

### 3.6 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground exterior-wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 7 Section "Through-Penetration Firestop Systems."

### 3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Perform tests and inspections and prepare test reports.
- C. Tests and Inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.
  - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- D. Test Reports: Prepare a written report to record the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.

3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 16120

## SECTION 16130- RACEWAYS AND BOXES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
  - 1. Division 2 Section "Underground Ducts and Utility Structures" for exterior ductbanks, manholes, and underground utility construction.

#### 1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. EPDM: Ethylene-propylene-diene terpolymer rubber.
- D. FMC: Flexible metal conduit.
- E. IMC: Intermediate metal conduit.
- F. LFMC: Liquidtight flexible metal conduit.
- G. LFNC: Liquidtight flexible nonmetallic conduit.
- H. NBR: Acrylonitrile-butadiene rubber.
- I. RNC: Rigid nonmetallic conduit.

#### 1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

## PART 2 - PRODUCTS

### 2.1 METAL CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems, Inc.
  2. Alflec Inc.
  3. Allied Tube & Conduit; a Tyco International Ltd. Co.
  4. Anamet Electrical, Inc.; Anaconda Metal Hose.
  5. Electri-Flex Co.
  6. Manhattan/CDT/Cole-Flex.
  7. Maverick Tube Corporation.
  8. O-Z Gedney; a unit of General Signal.
  9. Wheatland Tube Company.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Aluminum Rigid Conduit: ANSI C80.5.
- D. IMC: ANSI C80.6.
- E. PVC-Coated Steel Conduit: PVC-coated
1. Comply with NEMA RN 1.
  2. Coating Thickness: 0.040 inch (1 mm), minimum.
- F. EMT: ANSI C80.3.
- G. FMC:
- H. LFMC: Flexible steel conduit with PVC jacket.
- I. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
  2. Fittings for EMT: set-screw type.
  3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- J. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

### 2.2 METAL WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper B-Line, Inc.
  2. Hoffman.
  3. Square D; Schneider Electric.

- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type [1] [12] [3R], unless otherwise indicated.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type
- E. Finish: Manufacturer's standard enamel finish.

## 2.3 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Thomas & Betts Corporation.
    - b. Walker Systems, Inc.; Wiremold Company (The).
    - c. Wiremold Company (The); Electrical Sales Division.
- B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors.
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Butler Manufacturing Company; Walker Division.
    - b. Enduro Systems, Inc.; Composite Products Division.
    - c. Hubbell Incorporated; Wiring Device-Kellems Division.
    - d. Lamson & Sessions; Carlon Electrical Products.
    - e. Panduit Corp.
    - f. Walker Systems, Inc.; Wiremold Company (The).
    - g. Wiremold Company (The); Electrical Sales Division.

## 2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
  - 2. EGS/Appleton Electric.
  - 3. Erickson Electrical Equipment Company.
  - 4. Hoffman.
  - 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
  - 6. O-Z/Gedney; a unit of General Signal.
  - 7. RACO; a Hubbell Company.
  - 8. Robroy Industries, Inc.; Enclosure Division.
  - 9. Scott Fetzer Co.; Adalet Division.
  - 10. Spring City Electrical Manufacturing Company.
  - 11. Thomas & Betts Corporation.
  - 12. Walker Systems, Inc.; Wiremold Company (The).

13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- E. Metal Floor Boxes: semi-adjustable, rectangular.
- F. Nonmetallic Floor Boxes: Nonadjustable, round.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

### PART 3 - EXECUTION

#### 3.1 RACEWAY APPLICATION

- A. Minimum Raceway Size: 3/4-inch (21-mm) trade size.
- B. Raceway Fittings: Compatible with raceways and suitable for use and location.
  1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
  2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

#### 3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 16 Section "Electrical Supports and Seismic Restraints."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Raceways Embedded in Slabs:
  1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.

2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  3. Change from ENT to RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.
- I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than **200-lb (90-kg)** tensile strength. Leave at least **12 inches (300 mm)** of slack at each end of pull wire.
- L. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
1. **3/4-Inch (19-mm)** Trade Size and Smaller: Install raceways in maximum lengths of **50 feet (15 m)**.
  2. **1-Inch (25-mm)** Trade Size and Larger: Install raceways in maximum lengths of **75 feet (23 m)**.
  3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  2. Where otherwise required by NFPA 70.
- N. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed **30 deg F (17 deg C)**, and that has straight-run length that exceeds **25 feet (7.6 m)**.
1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
- O. Flexible Conduit Connections: Use maximum of **72 inches (1830 mm)** of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
  2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- P. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
- Q. Set metal floor boxes level and flush with finished floor surface.
- R. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

### 3.3 INSTALLATION OF UNDERGROUND CONDUIT

### 3.4 HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from **1/2-inch (12.5-mm)** sieve to **No. 4 (4.75-mm)** sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures **1 inch (25 mm)** above finished grade.

### 3.5 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.6 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Through-Penetration Firestop Systems."

### 3.7 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 16130